



# ***Gateway Arch Circulator Conceptual Feasibility Study***

## **Jefferson National Expansion Memorial**

*March 2015*



Jefferson National Memorial Expansion, Gateway Arch, St. Louis, MO  
Source: <http://69.24.67.243/wp-content/uploads/2012/04/GatewayArch.png>



*National Park Service Denver Service Center – Transportation Division*

**Volpe** *The National Transportation Systems Center*



U.S. Department of Transportation  
**Research and Innovative Technology  
Administration**



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Downtown St. Louis  
Great Rivers Greenway District  
Jefferson National Parks Association  
Laclede's Landing CID  
Missouri Department of Transportation  
National Park Service  
St. Louis Convention and Visitors Commission  
St. Louis Development Corporation



## Executive Summary

The Jefferson National Expansion Memorial (JEFF) is undergoing major design changes as part of the City Arch River 2015 project (CAR). The design changes include eliminating a large parking garage on park grounds and reconfiguring the road network immediately surrounding the park. In 2011, the CAR stakeholders conducted a preliminary investigation into the feasibility of providing a circulator service to facilitate mobility around the park as part of the design changes. Many of the changes to the road network are well underway and the Arch Parking Garage closed in December 2014. The purpose of this study is to review the feasibility of a circulator service at a conceptual level and recommend whether the park and CAR stakeholders should move forward with transportation service planning. The study team includes staff from the National Parks Service (NPS) Denver Service Center (DSC) and the U.S. Department of Transportation John A. Volpe Transportation Systems Center (Volpe Center).

The conceptual feasibility study began with a review of reports and designs for the CAR project, park visitation data, information from local transportation agencies and stakeholder interviews. The project team interviewed stakeholders in early autumn to understand organizational roles in CAR and St. Louis transportation and tourism related initiatives. Based on analysis of this information, the study team developed a set of preliminary goals and objectives for the circulator to guide development of route options. The goal of the circulator is to provide a visitor experience that is far greater than the sum of the parts: a safe, accessible and enjoyable experience for residents and visitors that encompasses the energy of the region, the power of the riverfront and the calm beauty of an urban national park. A proposed circulator needs to improve connections between the city, Arch and river and enhance the visitor experience while being sustainable and affordable.

Using the goals and objectives, the study team developed a set of circulator scenarios, conceptual operations, estimated costs and performed vehicle analyses that were shared with stakeholders during a 1-day workshop in St. Louis on November 6, 2014.

The workshop participants provided input on the goals, needs and expectations for the circulator and an initial range of circulator concepts, discussed the proposed scenarios in small groups, and were asked to develop alternative circulator options. The three resulting options included:

1. Expansion of the North, South and City Arch River Loops
2. A single condensed City Arch River Loop within park boundary and along City Garden
3. A single expanded City Arch River Loop operating entirely on city streets with an expanded downtown portion

The three groups reported back to the larger group and all participants were then asked to express their preference on the revised circulator options to enable the project team to move forward with development of a refined set of conceptual recommendations for the circulator routing, operational and financial considerations.

Further analysis of the workshop options was completed in consultation with the park and incorporation of additional related data and information. The study team recommends the

third option – a City Arch River Route which best links the city with the Arch and riverfront by operating on city streets, serving tourism destinations, and is complemented by rerouting the existing Downtown Trolley. This option creates stronger linkages between various parts of the downtown, the park and riverfront. Complementing the CAR partnership, the circulator serves a broader purpose, appeals to a wider ridership population, and distributes visitors throughout the downtown business district.

This circulator loop would operate with 5 minute headways in July, 10 minute headways in June and August, and 15 minute headways during the rest of the year. Since the recommendation operates a single loop in addition to the Downtown Trolley route, the recommended fleet size is three transit buses (including some regular service redundancy as well as greater capacity for July peak service.) The estimated operating and maintenance costs for the service are about \$1.6 million per year or about \$3.80 per passenger. A second scenario for the park and partners to consider is to discontinue service November through February when demand is expected to be lowest. The cost comparison of this scenario is also in the table below.

**Table – Executive Summary 1**  
**Estimated Operating Costs Over 12 Years for 2 Scenarios, with Fleet Replacement Costs.**

Source: Volpe Center

<b>Scenario 1 – Full Year Service</b>		
<b>Category</b>	<b>Notes</b>	<b>Estimated Costs</b>
Capital Costs	2 vehicles (base operations)	\$700,000
	1 vehicle (spare ratio/peak)	\$350,000
	Capital Subtotal	\$1,050,000
Maintenance & Infrastructure	Estimated new needs	\$300,000
Operations*	At 2% inflation	\$16,500,000
Vehicle Replacement (12 years)	Assumes 20% inflation	\$1,300,000
<b>TOTAL 12 YEAR COSTS</b>		<b>\$19,150,000</b>
Cost Per Year of the 12 Years	Simple breakdown by 12 years	~\$1,595,000
Cost Per Rider	Assumes 422,000 riders/year	~\$3.80
<b>Scenario 2 – March-October Service</b>		
<b>Category</b>	<b>Notes</b>	<b>Estimated Costs</b>
Capital Costs	2 vehicles (base operations)	\$700,000
	1 vehicles (spare ratio/peak)	\$350,000
	Capital Subtotal	\$1,050,000
Maintenance & Infrastructure	Estimated new needs	\$300,000
Operations*	\$1,200,000 per year for 12 years	\$12,000,000

Vehicle Replacement (12 years)	Assumes 20% inflation	\$1,300,000
<b>TOTAL 12 YEAR COSTS</b>		<b>\$14,600,000</b>
Cost Per Year of the 12 Years	Simple breakdown by 12 years	~\$1,217,000
Cost Per Rider	Assumes 360,000 riders/year	~\$3.40

\* Costs for marketing, branding, and partnering roles and responsibilities not included.

The conceptual study also included analysis of potential vehicles for the circulator service. The study team reviewed clean diesel, compressed natural gas (CNG) and all-electric transit style buses with buses that are used for similar service throughout the National Park Service. The analysis was based on meeting the preliminary goals and objectives of the circulator service, such as sustainability and visitor experience, and the conceptual service operations (annual hours, mileage, proposed route geometry, etc.) Workshop participants expressed interest in pursuing an electric fueled option, citing a preference sustainability perspective. An all-electric fleet would cost slightly more than a diesel fleet and slightly less than a CNG fleet to procure but significantly less than either diesel or CNG to fuel. An electric fleet would save between \$440,000 and \$610,000 in operational costs compared to a CNG or diesel fleet, respectively, based on U.S. Energy Information Administration (EIA) commodity inflation projections. Based on historical projections with a higher 8.5% rate for diesel, a 5% rate for CNG and a lower 1.9% inflation rate for electricity; an all-electric fleet could save between \$514,000 and \$824,000 compared to a CNG or diesel fleet, respectively. A battery-electric fleet is recommended for strong consideration for service based on cost considerations, the ability for the technology to meet the operational needs of the service, and sustainability objectives. However, the successful service implementation requires stakeholders to be engaged and the operating authority trained on operation and maintenance of new technology vehicles.

The proposed circulator service recommendation requires significant capital and operational funding. Partnering at federal and state levels will be required for system start-up. Additional partnering for operational fund sources and determination of a minimum threshold for rider revenue contributions is recommended.

Based on the results of the stakeholder workshop and analysis of operating scenarios, vehicle options, and funding feasibility, the study team recommends the park and CAR stakeholders continue with transportation service planning to refine circulator operating requirements for visitors and residents between downtown St. Louis, the Jefferson National Expansion Memorial and Mississippi River. During service planning, consideration should be given to marketing, branding, and partnering roles and operator responsibilities as critical service requirements and incorporated into operational cost proposals. Identifying project leadership and champions will be critical to next steps.



# Introduction

## *Project Purpose*

In 2011, the City Arch River 2015 project (CAR) stakeholders conducted a preliminary investigation into the feasibility of providing a circulator service. Such a circulator would support the CAR objectives to connect, invigorate and expand through improvements to the regional transportation system, the Gateway Arch grounds, and its surroundings. The resulting technical memo proposed a “transit circulator on the St. Louis Arch site to provide quick, convenient and accessible service between major visitor destinations.” An update of this technical memo has been requested to be provided by the National Park Service’s Denver Service Center, Division of Transportation, with the Volpe Transportation Systems Center (Volpe Center) providing technical assistance.

This Circulator Feasibility Study considers, at a conceptual level, whether to accommodate the significant visitation to Gateway Arch with a circulator system of shuttle buses to provide transportation to and from parking areas throughout St. Louis, downtown attractions, the park, and riverfront and recommends the park and CAR stakeholders move forward with detailed circulator implementation planning.

This National Park Service (NPS) update ***provides conceptually feasible transit circulator recommendations*** that review and update NPS and partner planning, development, operational and financial requirements. The conceptual recommendations are preplanning activities that demonstrate feasible capabilities to meet NPS and partner transportation goals.

The park can use the recommendations in this report to request funds to continue transportation service planning to refine circulator operating requirements. The park may also be able to request contributing agency funds for transportation service planning; National Environmental Protection Act/National Historic Preservation Act, (NEPA/NHPA) tasks; implementation, operational, and acquisition contracting tasks, as applicable.

This conceptual feasibility study began with a review of reports and designs for the CAR initiative, park visitation data, information from local transportation agencies and stakeholder interviews. The project team interviewed stakeholders in early autumn to understand organizational roles in the CAR Partnership, St. Louis transportation and tourism related initiatives. Based on analysis of this information, the study team developed a set of preliminary goals and objectives for the circulator to guide development of route options. The goal of the circulator is to provide a visitor experience that is far greater than the sum of the parts: a safe, accessible and enjoyable experience for residents and visitors that encompass the energy of the region, the power of the riverfront and the calm beauty of an urban national park. A circulator needs to improve connections between the city, Arch and river and enhance the visitor experience while being sustainable and affordable.

Using the goals and objectives, the study team developed a set of circulator scenarios, conceptual operations, estimated costs and performed vehicle analyses that were shared with stakeholders during a 1-day workshop in St. Louis on November 6, 2014. This report includes partner recommendations for a visitor experience centered transit circulator that

enhances connectivity, supports resource and community values, and achieves overall regional goals. Particular attention is directed to recommendations for appropriate vehicles, life cycle costs, and cost recovery strategies.

## *Background*

Jefferson National Expansion Memorial consists of the Gateway Arch, the Museum of Westward Expansion, and St. Louis' Old Courthouse. During a nationwide competition in 1947-48, architect Eero Saarinen's inspired design for a 630 foot stainless steel arch was chosen as a perfect monument to the spirit of the western pioneers. The Gateway Arch reflects St. Louis' role in the Westward Expansion of the United States during the nineteenth century. The park is a memorial to Thomas Jefferson's role in opening the West, to the pioneers who helped shape its history, and to Dred Scott who sued for his freedom in the Old Courthouse.

The park is currently undergoing a transformation to enhance physical and thematic connections to downtown St. Louis and the Mississippi River. In 2008, through a federal-local partnership, the Missouri Department of Transportation received a \$20 million TIGER grant for construction of the Park Over the Highway, and the renovation of Leonor K. Sullivan. The CityArchRiver Foundation was tasked with raising \$250 million in private donations to renovate the grounds and to construct a new entrance to the Gateway Arch grounds from the downtown. The Great Rivers Greenway used federal and local sales tax to construction the Leonor K. Sullivan project.

The agency partnership, as shown in Figure 1 on the following page, is comprised of representatives from the National Park Service Jefferson National Expansion Memorial, Bi-State Development Agency (BSDA), the CAR Foundation, the Great Rivers Greenway Organization and Jefferson National Parks Association. This partnership and representation from Missouri Department of Transportation (MODOT) and City of St. Louis own and manage national park system sites, city, state, and federal transportation system infrastructure, operate transportation systems and work within the Mississippi riverfront.

The City of St. Louis Port Authority has jurisdiction on the riverfront. NPS manages the Courthouse, Arch grounds, museum, and Luther Ely Square. BSDA operates the Arch tram, the riverfront boats and helicopter tour service through partnership agreements. BSDA also runs the MetroLink service and city bus system (including the Downtown Trolley.) Great Rivers Greenways develops and maintains multi-purpose trail systems within the St. Louis region, and the Missouri Department of Transportation is responsible for transportation infrastructure on the I-70/44 road corridor and Memorial Drive. The City of St. Louis has jurisdiction over city streets and Kiener Plaza, and is currently working on two major streetscape improvement projects in downtown St. Louis.

The concept for a vehicular circulator was initially referenced in the park General Management Plan (GMP) Record of Decision, in the original 2008 TIGER Grant revitalization proposal as a general need, and later explored in the 2011 draft ARUP Circulator Feasibility Report. The ARUP report explored the feasibility of providing a circulator to facilitate mobility around the national park and riverfront grounds as part of the design changes. In

the ARUP Report, the circulator was conceived as a tram operating on sidewalks and city streets, routing from the Courthouse, along the Arch grounds periphery, along the riverfront adjacent to the Arch grounds, and back to the courthouse. The ARUP report did not deliver a final recommendation and left a number of operational and funding considerations open for future consideration. Since that report was completed, many of the changes to the downtown St. Louis road network are well underway. The Arch Parking Garage closed in December 2014 and visitors are now encouraged to use local parking lots and garages to access the Arch grounds.



Figure 1: Agency Partnership

### City Arch River Goals

At the outset of the CAR project, CAR stakeholders established a set of overriding goals for the City-Arch-River Design Competition. These goals continue to be relevant today and provide guidance for this transportation planning effort. Creation of an Arch circulator (or shuttle) can enhance the park visitor experience by facilitating connections between the City Arch and riverfront, informing visitors about other opportunities in downtown St. Louis, as well as improve access to and from the riverfront. The goals are as follows:

- 1) Create an iconic place for the international icon, the Gateway Arch
- 2) Catalyze increased vitality in the St. Louis region
- 3) Honor the character defining elements of the National Historic Landmark

- 4) Weave connections and transitions from the City and the Arch grounds to the River
- 5) Mitigate the impact of transportation systems
- 6) Embrace the Mississippi River and the east bank in Illinois as an integral part of National Park
- 7) Reinvigorate the mission to tell the story of St. Louis as the gateway to national expansion
- 8) Create attractors to promote extended visitation to the Arch, the City and the River
- 9) Develop a sustainable future
- 10) Enhance the visitor experience and create a welcoming and accessible environment

### *City Arch River Boundary*

The CAR boundary includes area between 7<sup>th</sup> street to the riverfront, and along the riverfront from Chouteau on the south to Biddle on the north. The Arch grounds are located adjacent to the riverfront in the heart of the downtown area, which is undergoing extensive revitalization. Hotels, offices, restaurants, a new baseball park and football stadium, the St. Louis Convention center, the Riverfront Promenade Greenway, and many city parks exist within a mile or two of the Arch grounds. Connecting the CAR site with the City and Riverfront area beyond is a goal on which this project will focus.



Figure 2: City Arch River 2015 Project Area

## Data review, Site Visits and Stakeholder Interviews

### *Pre-Workshop Activities*

The conceptual feasibility study began with a review of reports and designs for the CAR project, park visitation data, information from local transportation agencies and stakeholder interviews. Relevant Studies reviewed included:

- Park GMP and Cultural Landscape Inventory
- CAR reports and 10 Design Goals,
- Michael Van Valkenburgh Associates (MVVA) pre-design report
- MVVA CAR Draft Circulator memo (ARUP 2011)

- Downtown Multi-Modal Study
- Arch Parking Alternatives Study
- Studies provided by Bi-State
- St. Louis Streetcar Feasibility Study
- Partner agency and organization websites
- Federal Highway Administration / CAR 2015 Access Justification Report for Concept Approval , 04/05 (ARUP, June 2012)

During a brief site visit in September 2014, project team members explored downtown St. Louis and nearby neighborhoods and walked the City-Arch-River area to better understand the project context and to meet with NPS and Bi-State Development Agency staff. Following the visit the project team interviewed stakeholders to understand organizational roles in CAR 2105 as well as St. Louis transportation and tourism related initiatives. Project stakeholders from the following agencies and organizations included:

- Bi-State Development Agency (BSDA)
- City Arch River 2015 Foundation
- City of St. Louis – Parks, Recreation and Forestry
- City of St. Louis – Planning and Urban Design
- City of St. Louis – Streets Department
- Downtown St. Louis
- Great Rivers Greenway District
- Jefferson National Parks Association
- Laclede’s Landing CID
- Missouri Department of Transportation
- National Park Service
- St. Louis Convention and Visitors Commission
- St. Louis Development Corporation

### *Stakeholder Interview Findings*

Most of those interviewed were aware of Circulator Conceptual Planning. Many shared common desires for the circulator and most agreed on broad goals and objectives for the circulator. There were some differences of opinions as to circulator routing which influenced initial routing scenarios prepared by the team to share with workshop participants; some perceived the circulator confined to a park centered transportation system and others suggested the circulator should operate exterior to park periphery and reach further into Downtown St. Louis. Most interviewed generally agreed that the timing is right for an integrated approach to planning the City Arch River visitor travel experience.

Stakeholders expressed opinions as to how the circulator should function and identified some of the destinations that should be served.

- Stop at key CAR destinations (Riverfront, Arch, Courthouse, North Gateway)
- Connect parking garages with park, link with on street bicycle facilities

- Extend to Mall, City Museum, Convention Center (carefully select stop locations that support attractions, some support for Union Station and Forest Park)
- Provide information on board to help visitors plan their trip
- Start simple, with limited stops, and be successful
- Maintain ability to be flexible and make adjustments to the circulator schedule
- Ensure the circulator responds to a problem that truly needs to be solved
- Should be more than a transit experience

There was also general agreement among stakeholders regarding what the circulator should not do and also where should it not go.

- Do not operate in congested corridors, or if so, should not impede the flow of traffic
- Do not duplicate other services
- Do not compete with local tours and tour industry
- Avoid operating on highway ramps and crossings
- There is a benefit to the visitor center by using the circulator to bring visitors to it, but not a benefit if it takes visitors away from the VC. There is a certain “dwell time” necessary to experience the park VC and visitors often underestimate it

### *Transportation / Visitor Experience Issues*

Based on discussions with park staff and information gleaned during stakeholder interviews, the study team identified transportation / visitor experience issues that may need to be addressed during circulator planning to improve safety and accessibility and to contribute to a high quality visitor experience. These include:

- The design changes underway include eliminating a large parking garage on park grounds and reconfiguring the road network immediately surrounding the park. This will change the way visitors access the park. The existing parking garage at the park has been torn down and visitors are now directed to park at four primary and 13 secondary garages within walking distance of the park. However, there is no real time information on parking availability at these garages.
- Currently there are no transportation services providing dedicated access to the Jefferson National Expansion Memorial.
- There are accessibility issues that need to be resolved.
  - Distances from parking locales in downtown St. Louis to the Courthouse and Arch are too far for many visitors to walk (whether in the heat of summer or cold of winter.) For example the Macy’s garage at Pine and 7<sup>th</sup> is a 10 minute walk from the Courthouse.
  - The vertical separation / distance between the Arch grounds and the river are difficult to overcome
  - Some visitors expect mobility assistance to be available between the parking locations and the museum entrance.
- There are many visiting scenarios to the downtown St. Louis / Jefferson National Expansion Memorial and each has differing wayfinding needs.
  - Currently visitors with the Arch as their primary destination arrive and park at multiple locations and make their way to the Arch. NPS is changing this visitor experience approach and is encouraging 1<sup>st</sup> time visitors (75 to 80 percent of

- all visitors) to arrive at the Courthouse first, then visit the Arch grounds and museum, go to the riverfront and then spend the balance of their trip exploring Downtown St. Louis.
  - Visitors may also be combining a visit to the Arch with a trip to a baseball game, or other destination in downtown St. Louis.
- Local residents who work downtown cannot easily get to the Arch grounds or riverfront without driving.
- There are impacts to circulation on the riverfront during high water, when traffic cannot run near the Mississippi River.
- The City of St. Louis experiences “gridlock” during sports events such as ball games. There is “incident management” for traffic on a regular basis.
- The riverfront will be closed to vehicular traffic during special events.
- There are no roads inside the parks’ security barrier. Pathways are fully dedicated to bicycle and pedestrian use and some pathways are dedicated to pedestrian use only. This would make it difficult if not impossible to implement a circulator within the park boundary.
- There are safety considerations with operation of a circulator on the park’s 18 foot wide perimeter path. Although the perimeter path was designed with the intent to accommodate pedestrians, bicyclists and the vehicular circulator, there are safety issues generated by combining (or mixing) all of these modes in a confined width space. Any proposed circulator concepts would need to separate of pedestrians and bicycles from circulator operations.
- There are constraints with operating a transit bus at the North Gateway, due to low clearance (less than 12’) at an existing overpass. Routing the bus to the north side of Laclede’s Landing would eliminate this constraint.

### *Goal and Objectives for the Circulator*

Using goals for the circulator provided by the park and input from stakeholders, the study team developed a set of preliminary goals and objectives for the circulator to guide development of route options.

#### **Goal**

The circulator should enable a visitor experience that is far greater than the sum of the parts: a safe, accessible and enjoyable experience for residents and visitors that encompasses the energy of the region, the power of the riverfront and the calm beauty of an urban national park.

#### **Objectives**

- Improve connections between City, Arch, and River
- Serve Visitor’s Needs / Enhance Visitor Walking Experience / Should be a fun and meaningful experience
- Provide simple, safe, convenient and efficient connections for visitors / working community and residents.
  - Make it easier for St. Louisans and visitors to safely access and enjoy a treasured monument and the space surrounding it
- Improve wayfinding and orientation, accessibility and comfort

- Let visitors know what else they can do in St. Louis. Contribute to extended length of stay.
  - Information aboard the shuttle could provide a window into the community.
  - Increase visitation and find ways to develop revenue from new visitors.
- The circulator should be a model for sustainability (vehicle and fuel)
- The circulator should be affordable to ride (Free or minimal cost, yet financially sustainable)

## Circulator Feasibility Study Workshop

### *Workshop Objectives and Outcome*

Based on analysis of the available information and stakeholder the study team developed initial circulator route scenarios, considered conceptual operations, estimated costs, and performed vehicle analyses on a range of options. The project team shared this information with stakeholders during a 1-day workshop in St. Louis on November 6, 2014. The workshop participants provided input on goals, needs and expectations for the circulator and an initial range of circulator concepts.



**Photo 1: Workshop participants**

During the workshop, stakeholders identified numerous ideas and opportunities for agency and organization involvement in marketing, funding, maintaining and operating a circulator. There was clear sentiment expressed that the agencies and organizations involved have a capability to plan, brand, fund and market, implement, operate, and maintain a circulator. Workshop objectives were:

- To gather stakeholder input on the initial range of circulator concepts
- Confirm whether the concepts meet the needs and expectations of CAR
- Confirm financial and operational requirements and stakeholders' willingness and capacity to implement

- Identify a potential operator for the circulator
- Receive concurrence to move the initial alternatives into a refined set of conceptual recommendations

### *Initial Workshop Circulator Route Scenarios*

The original routes proposed for consideration at the workshop included two parking loops providing service from downtown parking facilities to the park as well as a circulator providing access around the park itself for a total of three loops. Feedback from workshop participants indicated the parking connection loops were less critical than circulator access between downtown, the park and the river. Final routes, including individual route paths, destinations and schedules have not been determined; however there are common physical features shared by all potential routes. The potential routes would all traverse roads in downtown St. Louis, which are flat and resemble a low-speed, frequent ‘stop/start,’ urban duty cycle.

JEFF experiences significant visitation and suitable vehicles include transit-style vehicles which are designed for urban operating environments and are robust in design. Since the proposed shuttle service is a local service with a particular emphasis on providing access to the park for disabled and elderly visitors, a maximum-capacity (40+ passengers) transit bus was presumed to be too large and unwieldy and therefore was not considered. For this analysis, vehicles proposed are up to 30 feet in length and have a total capacity of 22-30 passengers, typical of medium-sized shuttles and transit vehicles.

## **Existing Transportation Infrastructure and Plans**

St. Louis has a transportation network that includes highways, arterials, city streets, public transportation, bicycle routes and pedestrian sidewalks. The various mode options are important for access to JEFF and need to be included as part of the overall system when evaluating circulation opportunities between downtown, the park and the riverfront. In addition to reviewing existing transportation systems and conditions in St. Louis, this conceptual feasibility study reviewed recent transportation plans and proposals that have impacts on the transportation system to ensure a potential circulator is in line with the City’s future visions.

### *Public Transportation*

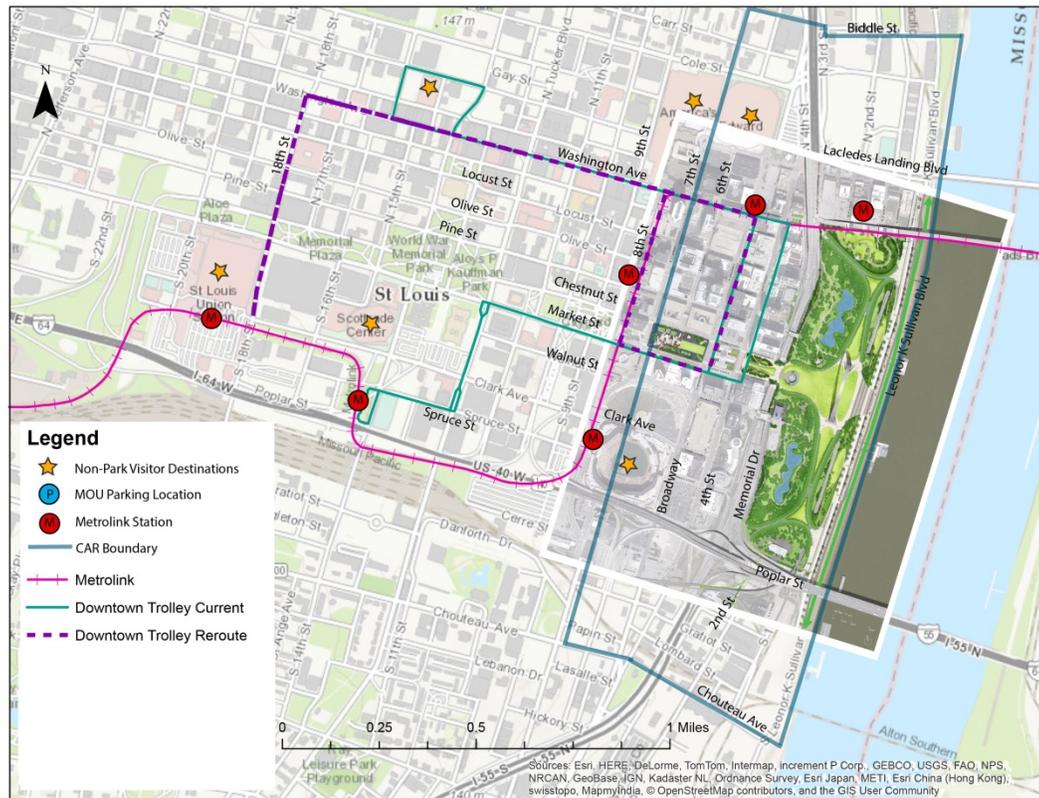
The public transportation system is run by St. Louis Metro Transit (Metro). Metro operates the City’s subway system, MetroLink, as well as local and commuter bus routes. There are six MetroLink stations within the downtown area. Laclede’s Landing is the closest station to the park, sitting just to the north of the park’s northern boundary. The monthly ridership of station correlates with park visitation, indicating its importance for access to the park. The Downtown Trolley is the local bus route operating in closest proximity to the park but does not run immediately adjacent to the park boundary. It operates between the Civic Center MetroLink station and the City Museum using N 4th Street and Broadway for north/south movement. Metro will be re-routing the Downtown Trolley starting in 2015 while the bus bays at Civic Center station are being expanded. It will serve Union Station and

the City Museum along a different path through downtown (see Figure 3). The 35 bus also runs north/south along 4th Street and Broadway through downtown without touching upon the park’s boundary. Metro also operates several express buses to serve commuters working in the downtown area; however, these routes do not have many local stops downtown near the park.

There are private transportation and shuttle services operating in St. Louis. The St. Louis Fun Trolley is a private operation that offers visitors a narrated tour through Downtown St. Louis for a fare. It is not an on/off service and takes about an hour to complete. The tour runs three times a day, six days a week. There are other private shuttles operating in downtown St. Louis to take students between campuses and housing or hotel visitors to various selected destinations.

**Figure 3 – Downtown St. Louis Transportation Map**

Source: Volpe Center, St. Louis Metrolink



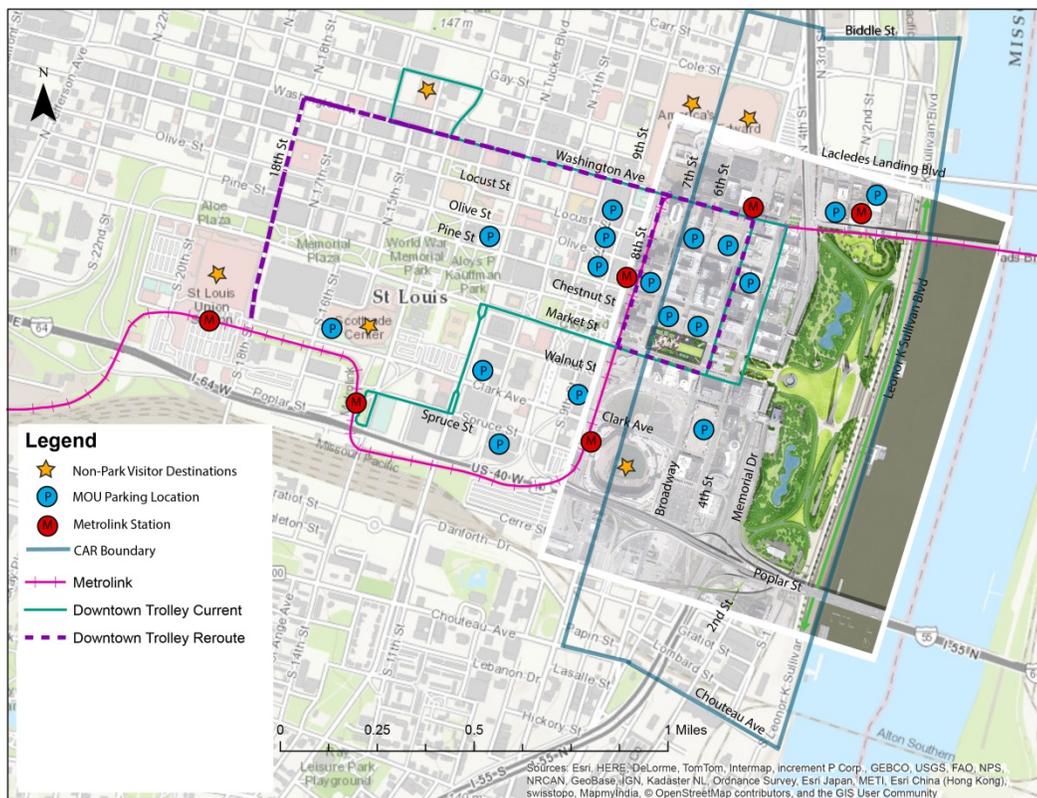
## Parking

Downtown St. Louis has more than 27,000 off-street parking spaces dispersed amongst garages and surface lots. The Arch Parking Garage, which had 1,143 parking spaces, was closed in December 2014 as part of the City Arch River project. It is scheduled for demolition and will not be replaced. Removal of the garage significantly alters the ability to access the park. Visitors to the park and park employees will have to park their vehicles in other garages and lots within the downtown area instead of parking on-site and walking approximately one-third of a mile to the Arch museum and tram.

In anticipation of the Arch Parking Garage demolition, the *Arch Parking Alternatives Study Final Report* was prepared in 2012.<sup>1</sup> The study documented available capacity of the 27,000 spaces within existing downtown garages (25) and lots (42) at approximately 13,000 spaces. The report goes on to make recommendations regarding alternatives to the Arch Parking Garage as well as wayfinding between the parking areas and the park.

**Figure 4 – Parking Area Map**

Source: Volpe Center, St. Louis Metrolink, Downtown Partnership for St. Louis



<sup>1</sup> Carl Walker, Inc. *Arch Parking Alternatives Study Final Report*. July 2012.

Since the report was released, the City's Convention and Visitors Commissioner (SLCVC) has engaged 17 parking operators in a Memorandum of Understanding (MOU) to participate in common wayfinding, maintenance and operations practices. The MOUs are intended to make it easier for visitors to find their way from the parking garages and lots to downtown destinations, including JEFF and the riverfront. The 17 parking locations represent approximately 4,700 available spaces after regular customers are accounted for. The MOU parking areas are on the map below and range from one-quarter to more than one mile from the park.

There are also plans to create a parking area designated for tour buses and recreational vehicles south of the park in the Chouteau's Landing area.

### *City Arch River Changes*

City Arch River is bringing about significant changes to the transportation network immediately surround JEFF. The park over the highway has closed northbound Memorial Drive between Walnut Street and Washington Avenue, as well as southbound Memorial Drive between Chestnut and Market Streets. The Pine Street Bridge has been made pedestrian only. The reconstruction of Leonor K Sullivan Boulevard, which is currently underway, will significantly change the function and look of the road. It will go from four to two bi-directional lanes and add a separated bike lane on the east side. As mentioned before, closure of the Arch parking garage removes 1,143 parking spaces from park grounds. Finally, Washington Avenue will be closed from Memorial Drive to Leonor K Sullivan Boulevard. This area will become part of the north gateway into the park. A small road segment will remain on the south side of Eades Bridge between 1st and 2nd Streets. The street closures and lane reductions change the circulation patterns around the park. These changes require careful consideration in the design and development of a circulator system.

### *Multimodal Study*

In 2014, the St. Louis Development Corporation and Partnership for Downtown St. Louis<sup>2</sup> commissioned a multi-modal access study as follow up to the Downtown Next 2020 Vision Plan. The study emphasizes improvements for walkability, transit use and bicycling through a complete streets lens. The goals of the study are a welcoming downtown, a downtown that attracts people to stay, accessibility, wayfinding and connectedness and these goals are incorporated within the circulator. The study was developed around 4 guiding principles to simplify transportation, improve efficiency, provide a range transportation options, and improve how the streets are viewed by users. It includes a number of actions and modal plans, including complete street designs, bus rapid transit, multi-use paths and streetscape improvements.

### *St. Louis Street Car*

The St. Louis Streetcar study and proposal were also developed in support of Downtown Next 2020 Vision plan. One of the goals in the Downtown Next plan is "Making Downtown Accessible and Easy to Get Around." The purpose of the streetcar is to give access to jobs, housing and destinations in the city through services that complement existing Metro

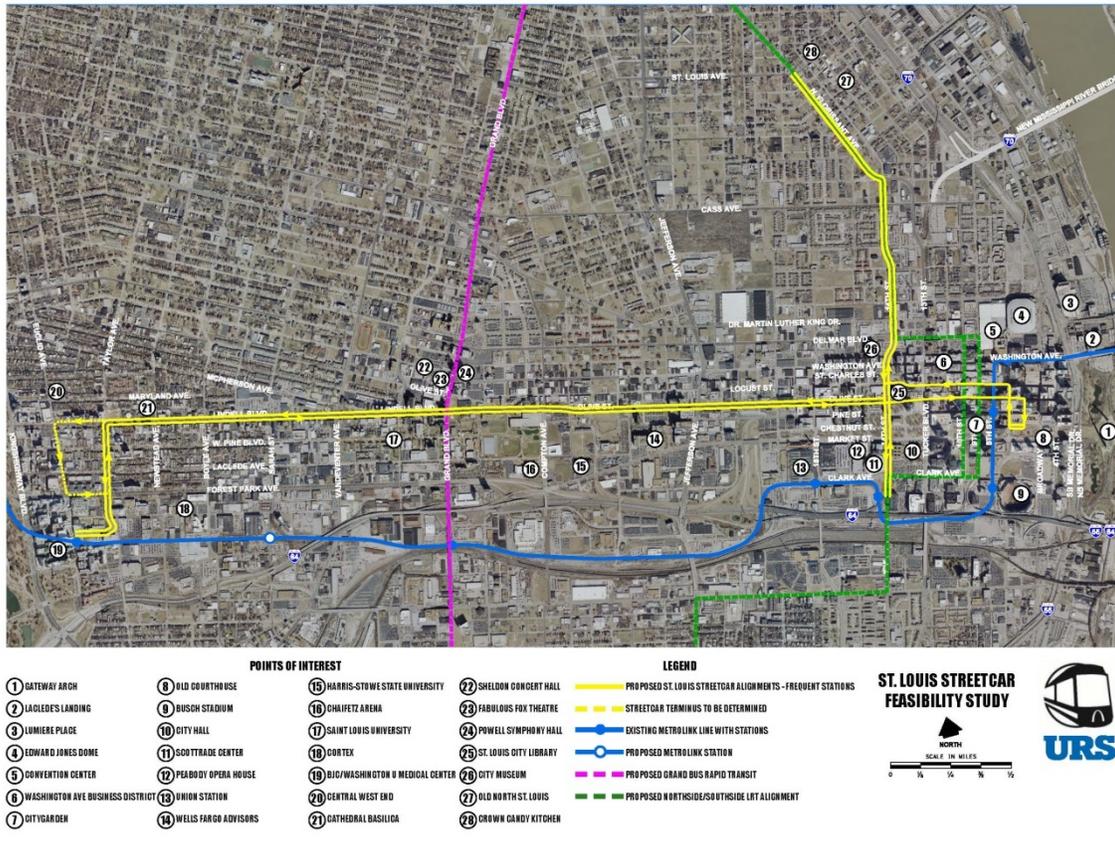
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<sup>2</sup> Partnership for Downtown St. Louis was renamed Downtown STL, Inc. in late 2014.

services. It adds to the regional transit system and helps create a catalyst for economic development. The relocation of the St. Louis University Law School from midtown to downtown contributes to the viability of the street car proposal by providing two significant anchor points. It is conceivable that the circulator routing could complement the streetcar routing.

**Figure 5 – St. Louis Street Car – Proposed Alignment**

Source: Downtown Partnership for St. Louis



## JEFF Visitation and Transit Demand Projections

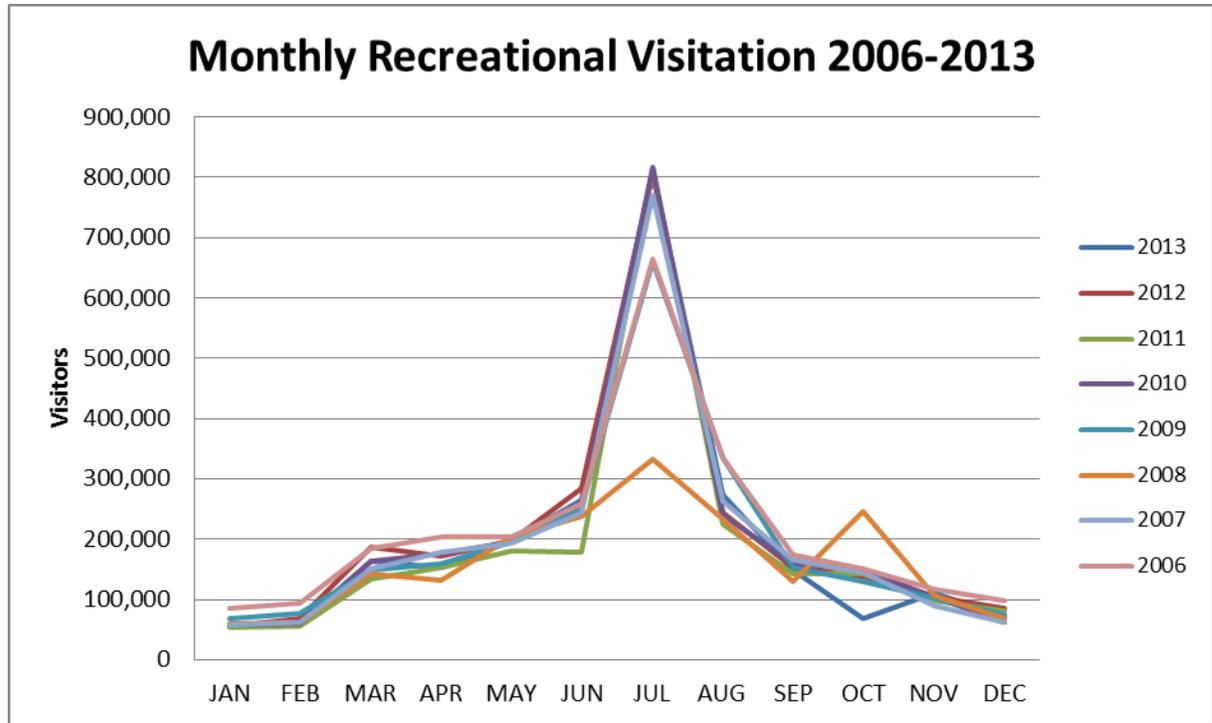
Ridership for a circulator between downtown St. Louis, JEFF and the riverfront will likely be largely driven by park visitation. Between 2009 and 2013, JEFF averaged nearly 2.4 million visitors.<sup>3</sup> In 2012, the University of Idaho conducted a visitor survey to better understand who is visiting the park. Of the visitors surveyed, more than one-third were visiting St. Louis with the park as their primary destination while another 50% had planned to visit along with another primary destination. Nearly 60% of the visitors were visiting the park for the first time.

<sup>3</sup> NPS Public Use Statistics Office

Visitation to the park is extremely peaked in the summer, with July receiving about 30% of total annual visitation (~780,000). 70% of all visitors arrive between March and August while only 8% of visitors come to the park between December and February. These patterns are extremely important to understand since it can pose a challenge to circulator service planning.

**Figure 6 – Visitation to JEFF by Month**

Source: Volpe Center, NPS PUSO



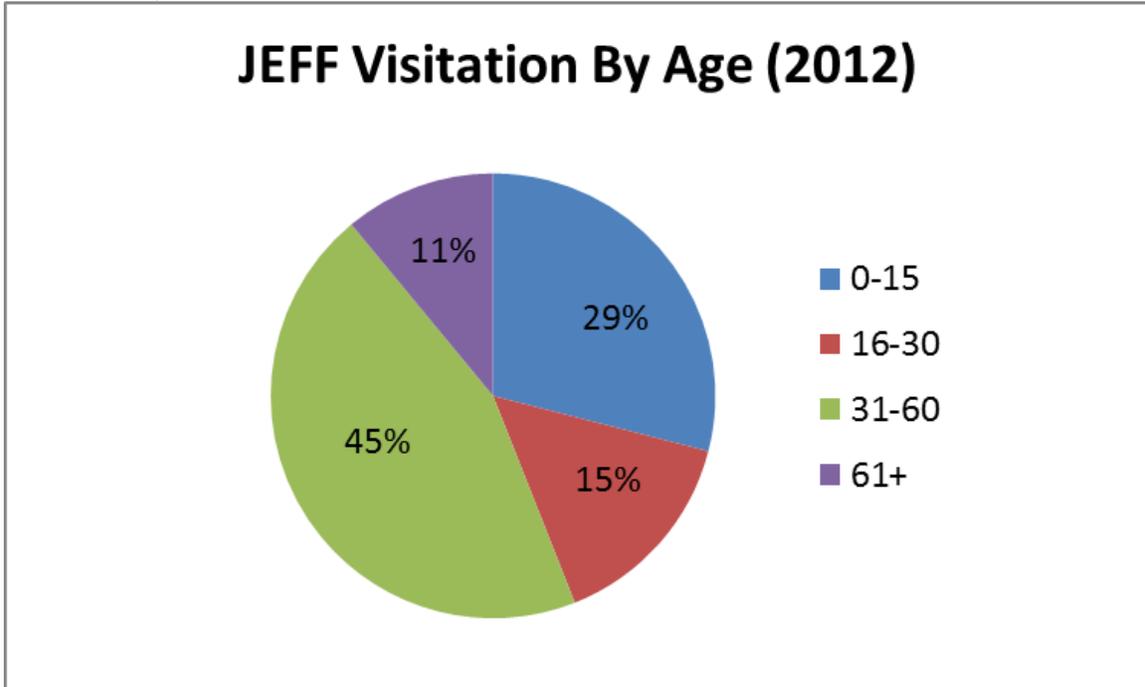
Note: In 2008, high waters and flooding of the Mississippi River forced the relocation of Fair St. Louis and cancellation of other events, which had significant impacts of visitation that summer. However, a rally for Barack Obama’s presidential campaign was held in the park in October 2008, providing a boost to visitation that month.

As shown in Figure 7, the majority of visitors to JEFF are between the ages of 16 to 60 (60%). Visitors under the age of 16 account for almost one-third of visitors – nearly half of those are under the age of 10. Those over the age of 60 make up 11% of visitation.<sup>4</sup> Additionally, 5% of survey participants identified themselves as having limited mobility. Persons with limited mobility, children under the age of 10 and seniors over the age of 60 are more likely to need assistance walking long distances, especially in more extreme temperatures.

<sup>4</sup> Marc F. Manni, James Gramann, Yen Le, Steven J. Hollenhorst. 2012. *Jefferson National Expansion Memorial Visitor Study*. Visitor Services Project, Park Studies Unit, College of Natural Resources, University of Idaho [http://psu.uidaho.edu/files/vsp/reports/256\\_JEFF\\_rept.pdf](http://psu.uidaho.edu/files/vsp/reports/256_JEFF_rept.pdf)

**Figure 7 – Visitation to JEFF by Age**

Source: University of Idaho, Park Studies Unit, 2012



The vast majority of visitors are traveling in family groups. This is an important characteristic since family groups are more likely to stay together throughout their visit, which would require adequate capacity on circulator vehicles.

Another important result of the survey is that nearly 70% of participants indicated parking in the Arch garage. Assuming the survey is representative of all visitation to the park and that 70% of visitors use the Arch Parking Garage, closure of the garage means about 1.7 million people will need to find another place to park within downtown St. Louis, which range from one-quarter to more than a mile from the park grounds.

Using the visitor demographic information, we are estimating that potential circulator ridership could be as high as 20% of total visitation or 477,000 riders per year. The ridership is not distributed evenly across months. It ranges from a high of 150,000 in July to a low of around 12,000 in January.

## Proposed Circulator Scenarios

In preparation for the November 2014 workshop, the study team reviewed the relevant background data and developed conceptual scenarios for the circulator. These were presented to the stakeholders and the workshop for consideration and as a starting point for discussion. The original routes proposed for consideration at the workshop included two parking loops providing service from downtown parking facilities to the park as well as a

circulator providing access around the park itself for a total of three loops. Feedback from workshop participants indicated the parking connection loops were less critical than circulator access between downtown, the park and the river. Final routes, including individual route paths, destinations and schedules have not been determined; however there are common physical features shared by all potential routes. The potential routes would all traverse roads in downtown St. Louis, which are flat and resemble a low-speed, frequent 'stop/start,' urban duty cycle.

JEFF experiences significant visitation and suitable vehicles include transit-style vehicles which are designed for urban operating environments and are robust in design. Since the proposed shuttle service is a local service with a particular emphasis on providing access to the park for disabled and elderly visitors, a maximum-capacity (40+ passengers) transit bus was presumed to be too large and unwieldy and therefore was not considered. For this analysis, vehicles proposed are up to 30 feet in length and have a total capacity of 22-30 passengers, typical of medium-sized shuttles and transit vehicles

Feedback from the stakeholder interviews highlighted the need for connectivity between the downtown, park and riverfront. The closure of the Arch parking garage was a major consideration in the development of the circulator scenarios. The study team developed four circulator loops that could be implemented separately or in combination as the system matures. Each route is 2.25-2.75 miles long and would take approximately 15 minutes to complete with average traffic. The workshop scenarios include:

- Arch-River Loop – This route essentially offers rides between the park entrance and the river.
- City-Arch-River Loop – This route repeats the Arch-River loop and adds a segment further into Downtown along the Gateway Mall to provide access to downtown locations.
- North Parking Loop – The north parking loop provides circulation between MOU garages north of Kiener Plaza and City Garden.
- South Parking Loop - The north parking loop provides circulation between MOU garages north of Kiener Plaza and City Garden.

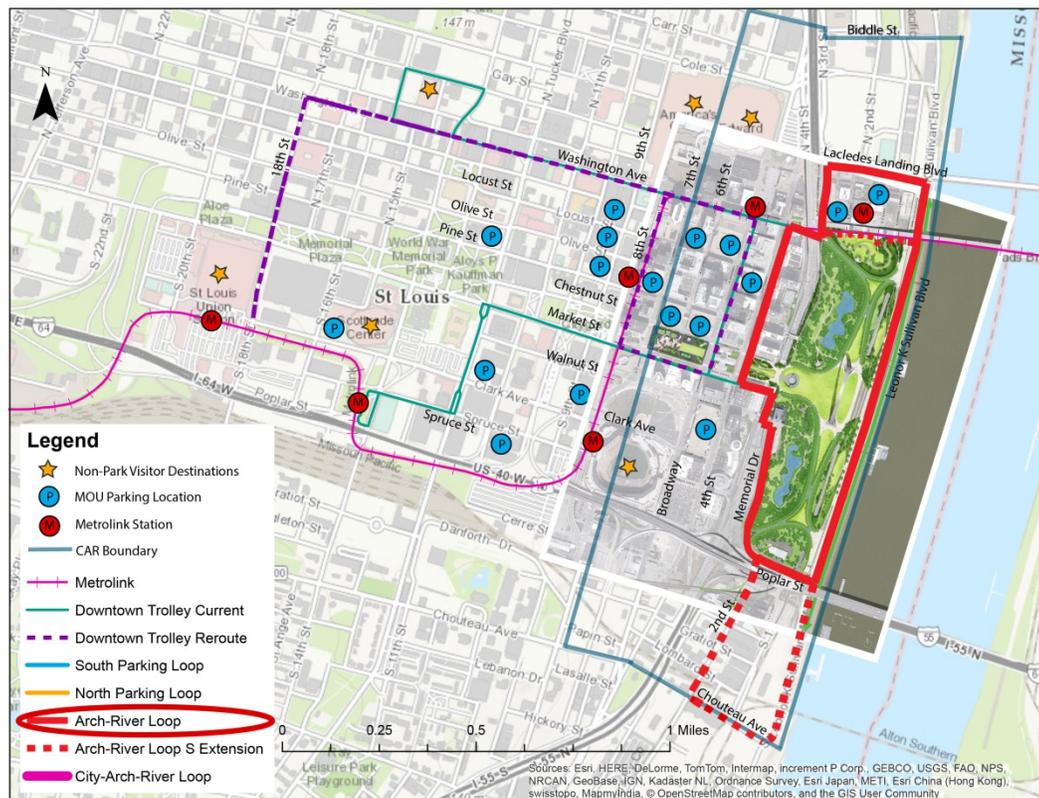
## Arch-River Loop

This route is designed to facilitate movement between the Old Courthouse and Arch entrance and the riverfront. Several stakeholders mentioned the importance of access to the riverfront as a key objective of the circulator. It appears in bright red on the map in Figure 8. This route includes 2 sub-options that can be considered. These are shown in dashed green lines and the north and south ends of the park.

The route starts on Market Street and Memorial Drive near the park over the highway. From Market Street it turns north on 4th Street towards Laclede's Landing via Washington Avenue. It goes up Memorial Drive/N 3rd Street and east on Laclede's Landing Boulevard to Leonor K Sullivan Boulevard (LKS Boulevard). The north side sub-option for consideration is to have the vehicle enter the park area at northwest corner and travel along the north path to LKS Boulevard. This option needs special consideration based on the design of the pathway, whether it can accommodate a street transit vehicle and how the presence of the vehicle could impact the visitor experience. The route continues south along LKS Boulevard and returns to the starting point via Poplar Street and Memorial Drive. The second sub-option would continue on LKS Boulevard to Chouteau Avenue and then north on 2nd Street. This option would provide access to the planned RV/bus parking area.

**Figure 8 – Arch-River Loop Proposed Route**

Source: Volpe Center

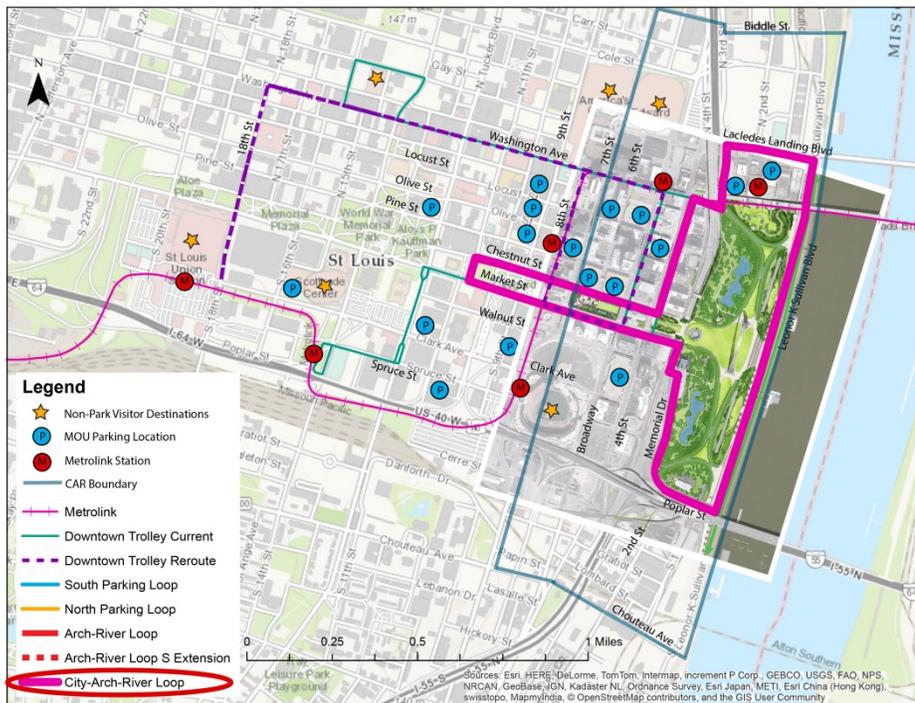


## City Arch River Loop

The CAR Loop, which is in pink in Figure 9, is designed to facilitate movement between downtown along the Gateway Mall, Arch entrance and the riverfront. It reaches deeper into the city than the Arch-River Loop. It is an expanded version of the Arch-River loop. Instead of going down 4th Street from the starting point, it would continue east on Market Street to 11th Street. It returns west along Chestnut Street before turning north on 4th Street towards Laclede's Landing via Washington Avenue. It goes up Memorial Drive/N 3rd St and east on Laclede's Landing Boulevard to LKS Boulevard. It continues south along LKS Boulevard and returns to the starting point via Poplar Street and Memorial Drive. The 2 sub-options from the Arch-River loop are also applicable to this route with the same nuances.

**Figure 9 – City-Arch-River Loop Proposed Route**

Source: Volpe Center

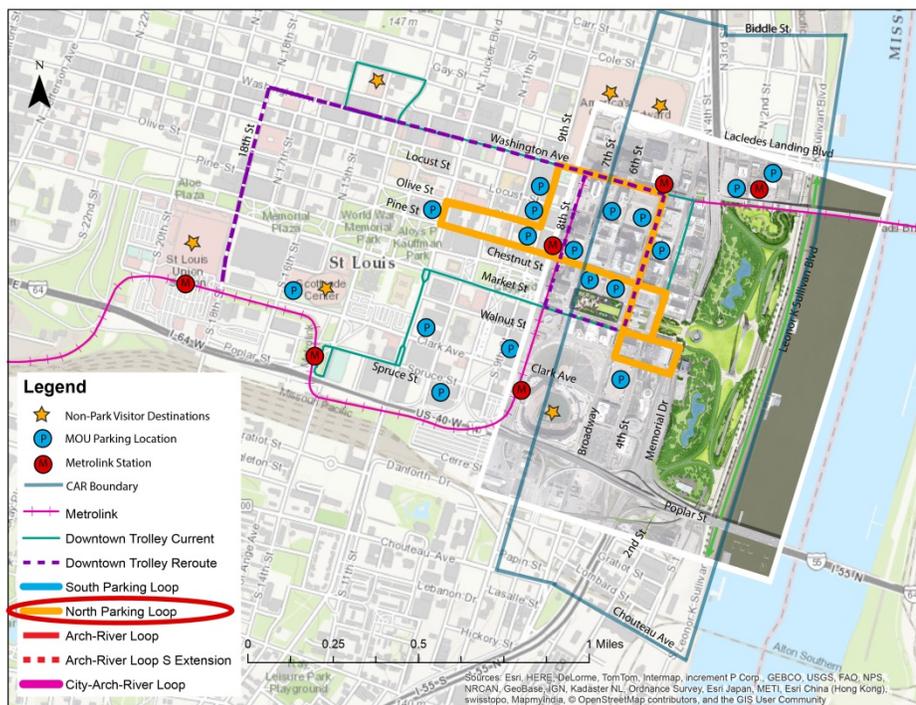


## North Parking Loop

The north parking loop appears in orange/yellow on the map in Figure 10. The design of this route is to capture 12 parking locations on the north side of Kiener Plaza and City Garden. It starts on Market Street and Memorial Drive near the park over the highway, which is the common start and end point for all of the circulator options. It goes across 4th Street and then west on Pine Street up to N Tucker Boulevard. The route goes east on Olive Street to 9th Street. After going north on 9th Street to Washington Avenue, it goes east on Washington Avenue by the convention center before returning to the start via Broadway and Walnut Street. The stops could be at or in close proximity to the parking areas shown.

**Figure 10 – North Parking Loop Proposed Route**

Source: Volpe Center



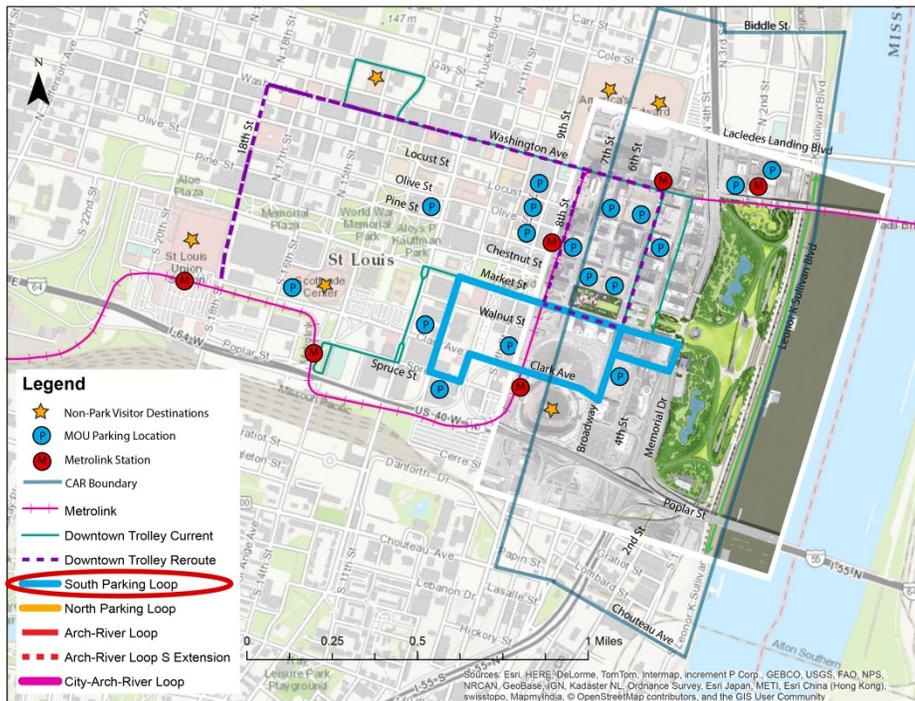
## South Parking Loop

The south parking loop, shown in aqua blue in Figure 11, is designed to capture 4 parking locations on the south side of Kiener Plaza and City Garden. It also starts on Market Street and Memorial Drive near the park over the highway. The route goes west on Market Street and turns south on Broadway. It turns west up Clark Avenue before going south on 10th Street. It goes east on 11th Street and returns west along Market Street. The route uses Broadway and Walnut to return to the starting point. The stops could be at or in close proximity to the parking areas shown.

The two parking loops can be operated as a single loop or as two separate loops. There is one additional parking location near the Scott Trade Center. It is the farthest from the park and within 2 blocks of both Union and Civic Center Metro stations. The team chose not to include this one on the circulator route based on its proximity to Metro and the impact it would have on the route length and travel times for the south parking loop.

**Figure 11 – South Parking Loop Proposed Route**

Source: Volpe Center



## Circulator Routing from Workshop Discussion

Stakeholders participating in the workshop broke into working groups to discuss the proposed circulator routes and suggest revisions based on their understanding of need for the service. The three resulting options included an expansion of the three loops, a single condensed City Arch River loop that primarily operates within the park boundary and along the City Garden, and a single larger City Arch River Loop that remains on the City streets and has an expanded downtown portion. The three groups reported back to the larger group and all participants voted on the revised circulator options.

### Group 1 Concept - Expansion of the North, South and City Arch River Loops

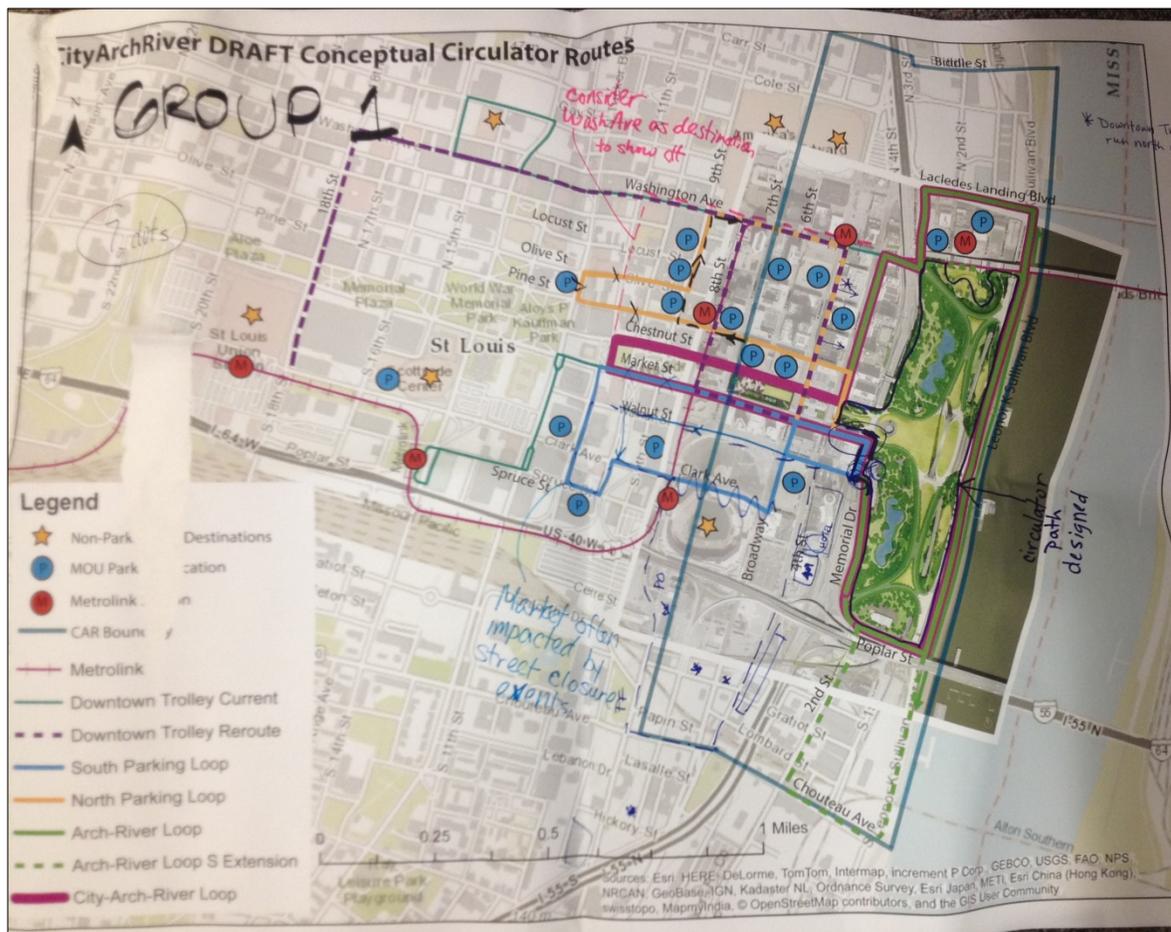


Figure 12: Group 1 Concept

This Circulator concept utilizes three loops running separately for best coverage. These include the North Loop, South Loop, and Park circulator. The Park circulator would offer an interpretive program.

Group 1 identified 3 main needs:

- 1) To get people safely from parking lots to the park

- 2) Provide access to the river and back
- 3) Provide an interpretive component around the Arch park periphery

Talking Points:

- This route uses the existing designed circulator path on park perimeter and has a northern loop that runs counterclockwise (north on 9<sup>th</sup> St., east on Washington, south on Broadway, west on Market, north on 7<sup>th</sup> St, West on Pine to 9<sup>th</sup> St. The separate southern loop runs south on 8<sup>th</sup> Ave to Chouteau Ave. east on Chouteau Ave, north on 4<sup>th</sup> St, West on Walnut St, south on 10<sup>th</sup> St, east on Clark Ave to 8<sup>th</sup> St.
- Market is often impacted by “street closure” events.
- The CAR route works as routed between downtown and the river. The route could be adjusted during parades.
- It recognizes that the Park Circulator path is designed.
- Consider Washington Avenue as a destination to show off
- The southern route could move off Market and onto Walnut. This avoids overlap with the CAR loop. One advantage is that it would serve more parking lots on the south.
- The north loop should reach the City Museum; however that would require many turns. Removing the Tucker extension would alleviate this.
- Consider using 9<sup>th</sup> as the westernmost extent of the routing.
- Pick up the Park Pacific lot with the CAR loop.
- The park circulator is interpretive program based and is not really transportation. It could offer good access to the riverfront. It should not be bus based, unless it is really necessary as a follow on step. It could be “donor” based or run only during special events. But if it is a “tug” it won’t likely have enough capacity to serve anticipated ridership.
- The Downtown Trolley service could complement this routing so that service could be seamless.
- There would be opportunity to expand the south loop service to Chouteau, when needed.
- Because Market tends to be closed often the South loop could be moved off Market to avoid confusion.
- The “blue line” on Walnut should be retained.
- The City Arch River Loop which runs along the Gateway Mall could be truncated during parades which could keep transit access running to the riverfront at all times.
- Headways should mimic the Park’s extended operating hours.
- Visitors need to be informed of these systems.
- There would be some outlying areas that would not be served, but there should be ways to transfer to other city transit routes.
- Branding and “bus wrapping” needs to be similar for all buses / vehicles.
- Need to consider how to best work with the Downtown Trolley to minimize overlapping or supplanted service, and optimize shared resources and funding opportunities.
- There needs to be a night bus to serve after hours use.
- Special events can affect the transit network on multiple days.

This concept received 5 votes out of 50 votes cast by workshop participants.

## Group 2 Concept - Single Condensed City Arch River Loop

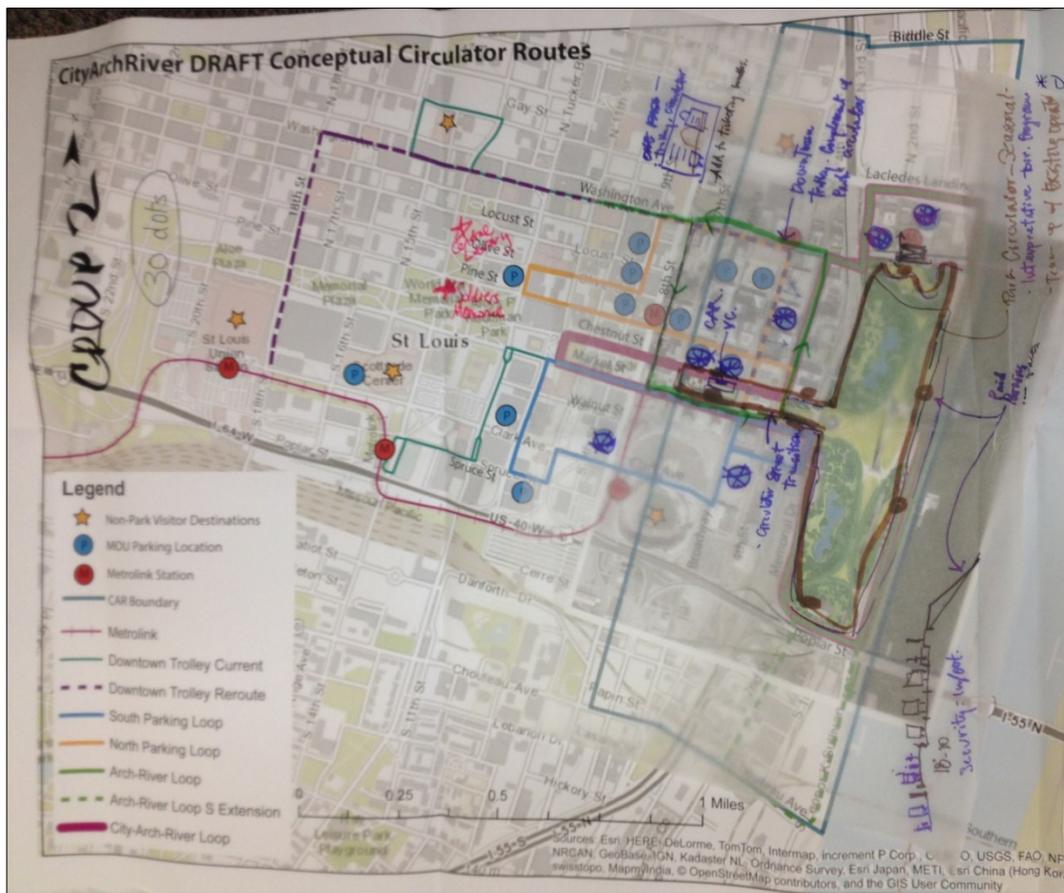


Figure 13: Group 2 Concept Single condensed City Arch River loop within park boundary and along City Garden

This group opted to set aside the 3 separate loops and refocus circulator service on one entire loop around the park periphery, using the circulator path already designed and also operating on city streets. The Downtown Trolley could be rerouted to bring visitors from the parking garages to the Park and Riverfront. The circulator could start by running along the park periphery but could expand to unify the entire Gateway Mall area in the future.

### Talking Points:

- The park circulator would start at the old Courthouse plaza, which is the launching point for the Park visitor experience. It would run seasonally and offer an interpretive tour, but would team up operations with the existing transit provider service (Bi-State.) It would transition from the perimeter path and run on city streets along the Gateway mall up to 7<sup>th</sup> St. Stops would be located at the Courthouse Visitor center, on market and Chestnut between Memorial and 4<sup>th</sup> St, at the north gateway, on the Riverfront promenade, and on Poplar St.
- The Downtown Trolley route could expand to connect to other city attractions and would continue to operate on city streets and would complement the park circulator. It would run counter clockwise, east on market past the Courthouse, north on 4<sup>th</sup> St, West on Washington Avenue and south on 8<sup>th</sup> St. Stops would be located on

Broadway, at the Courthouse visitor center, and near Walnut St. and Clark Avenue. It could also serve the convention center during events. This would connect Kiener East and West and Stadium East Garages. There would continue to be a fare to ride the Downtown Trolley.

- Downtown Trolley passengers desiring access to the Gateway Arch and the Riverfront would need to transfer to the park circulator.
- The vehicle would be a battery powered tug. (Could this vehicle protect visitors from inclement weather? Can it also legally operate on city streets?)
- The park visitor center could offer a ticketing package which includes the circulator loop. Ticketing booths at other venues could offer trolley and circulator tickets in base prices of events tickets.
- Concept includes a secured paid parking lot for 18-20 vehicles on the riverfront.
- One assumption is that visitors to the Arch will park as close to the Park as possible or stay in hotels close to the Arch.
- If MetroLink could be more fully incorporated into the visitor travel experience then seamless connections would be possible. For example, Arch Circulator routing needs to be included in city transit maps.

This concept received 30 votes out of 50 votes cast by workshop participants.

## Group 3 Concept - Single Expanded City Arch River Loop

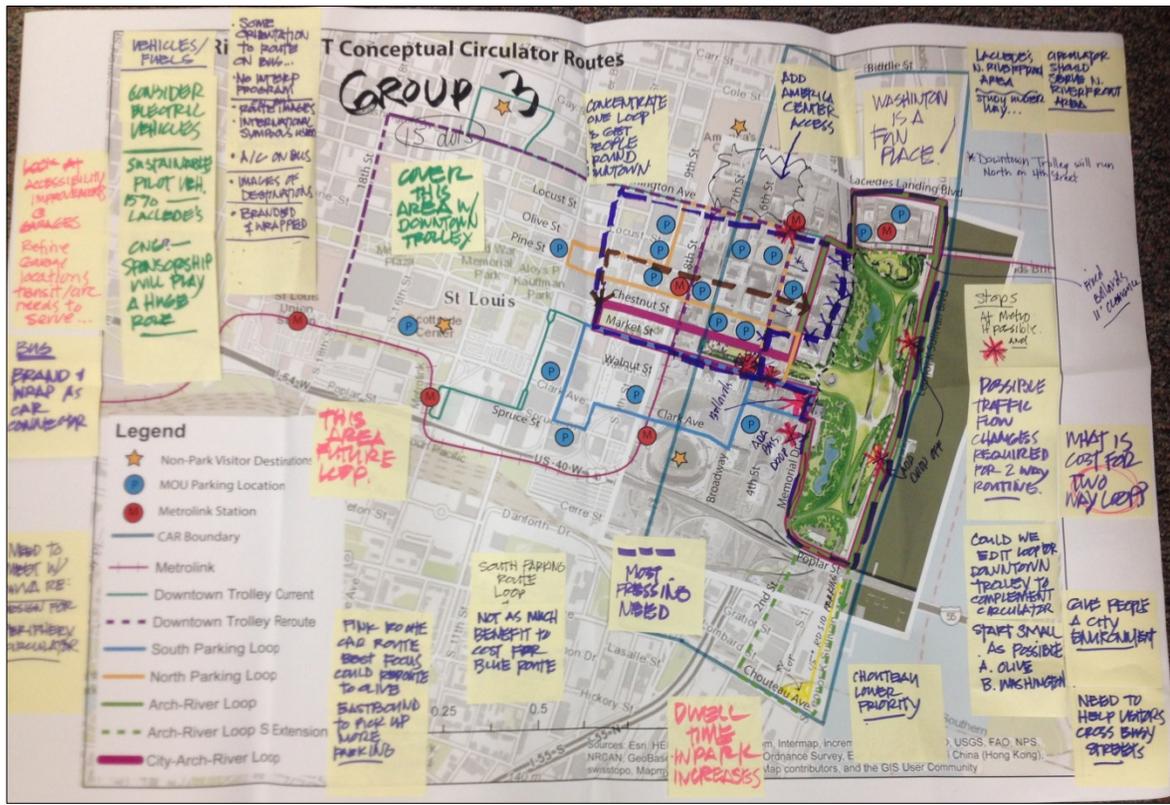


Figure 14: Group 3 Concept: Single expanded City Arch River Loop operating entirely on City streets with an expanded downtown portion

This is a dedicated route that takes visitors to the Arch but also connects the Arch and Riverfront with downtown St. Louis. It focuses service on the north side first and leaves the south side open to consideration.

### Talking Points:

- Initially it would run as a clockwise loop starting on Market at the Courthouse visitor center to 11<sup>th</sup> St, to Washington Avenue, north along Memorial to Laclede's Landing Blvd, south along the riverfront to Poplar Street, west to memorial. Stops would be at Metro stops if possible, at the Courthouse visitor center, on Memorial Drive as close to the Arch museum as possible and also on the riverfront.
- It should connect the park with the downtown area along Washington Avenue but could extend up to St. Louis Station to 20<sup>th</sup> to Washington. Could also extend to Chouteau.
- It could be a redesigned Downtown Trolley route and could be operated by Bi-State
- The system would operate seasonally and could be truncated during flooding or re-routed during special events.
- To ensure that riding this route would be as easy as possible it would not require any transfers. This is best for persons with mobility impairments.
- The trolley could grow and be branded with the Gateway Arch to show that it goes to the Arch.

- There is a lot of activity in Laclede's landing with Great Rivers Greenway. Cobblestones are problematic for people with disabilities and a circulator would alleviate those difficulties.
  - It improves safety helps visitors to cross busy streets.
  - Some members of Group 3 were in support of implementing a Park periphery circulator and others suggested it was really not necessary and that people could experience the arch grounds on new accessible paths.
  - Electric vehicles should be considered, possibly in a pilot operation. Sponsorship will play a huge role in determining the type of fuel and vehicles used.
  - There would need to be some orientation to the route on the bus, but no interpretive program. Images of destinations served, multiple languages or universal symbols would be appropriate and the buses could be branded and wrapped as the "City Arch River Connector."
  - The CAR Loop could traverse Olive St eastbound to pick up more parking.
  - The City could consider traffic flow rerouting to accommodate a two-way loop.
  - Consider accessing America Center
- This concept received 15 votes out of 50 votes cast by workshop participants.

### *Other ideas recorded during the workshop*

1. Consider marketing a multi-modal stay and highlight areas for half day, full day two day and perhaps a three day length of stay.
2. Strong visitor services exemplify the vibrant Park and City.
3. There is a need to get visitors across two highly congested traffic areas
4. A future light rail station on memorial could happen if funded by a TIGER Grant in 2021.
5. Think about the visit in terms of seasonality, numbers of visitors and length of stay.
6. The St. Louis Experience typically starts out strong and could end the day with use of a transit mode.
7. It's about making connections and keeping visitors happy.
8. Need to craft a route during special events and extended summer hours
9. Ridership will increase during 81 game days during the year (special events)
10. Operations cost for Metro is roughly \$64 per hour, so costs are very low compared to other transit systems
11. We may need to select a different styled vehicle for the circulator
12. Consider having a 20% spare ratio. If 9 buses are to operate 11 buses would need to be acquired.
13. Employees are not included in visitation counts, so they would need to be factored in to ridership
14. Confirm total cost of ownership
15. Tug costs for a park periphery system could run 6 to 7 years and could be 28 to 60K. There would be no salvage value for this type of equipment. Circulating in or around the park only would be a very simple route.
16. There may be issues with mixing transit buses and visitors
17. Consider issues with keeping transit moving on LKS with buses stopping there.
18. May need "boots on ground" traffic management during start up and beyond and for traffic management during special events and during high water (periodic flooding.)

19. Parade permitting could be re-evaluated to mitigate traffic impacts.
20. Work with City streets Department during implementation.
21. Increase appeal to mobility impaired visitors
22. Bundle fee to operate system
23. Scale service to serve a reasonable number of visitors so the system can be sustained over time.

Following the workshop the study team received some additional feedback from Downtown St. Louis staff. The study team took points expressed in this memo into consideration while developing the feasibility study recommendations. This informal communication is included in Appendix A.

## Proposed Circulator Recommendation

### *Concept*

To best meet the CAR Partnership vision and travel needs of visitors and St. Louisans to downtown St. Louis and Jefferson National Expansion Memorial, the study team recommends implementing a City Arch River Circulator that connects the Jefferson National Expansion Memorial, the nearby riverfront and downtown St. Louis destinations. The circulator should enable an experience that is far greater than the sum of the parts: a safe, accessible and enjoyable experience for residents and visitors that encompasses the energy of the region and downtown St. Louis, the power of the riverfront and the calm beauty of an urban national park.

Upon further reflection and analysis of the options that were developed by the workshop participants, along with application of visitor experience scenarios, standard transit planning practices and design operational data, this recommendation blends the best ideas from the workshop participants, resulting in a travel experience that picks the best attributes of each of the three concepts. Driven by market demand, financial and operational feasibility considerations, a route that connects Arch visitors with attractions in the downtown area would support seamless transportation system connections, could generate an extended length of stay, and provide a more enhanced visitor experience. This circulator service would serve near term development and future planned riverfront development and management as well as the Downtown St. Louis Multi Modal study 2020 vision and goals.

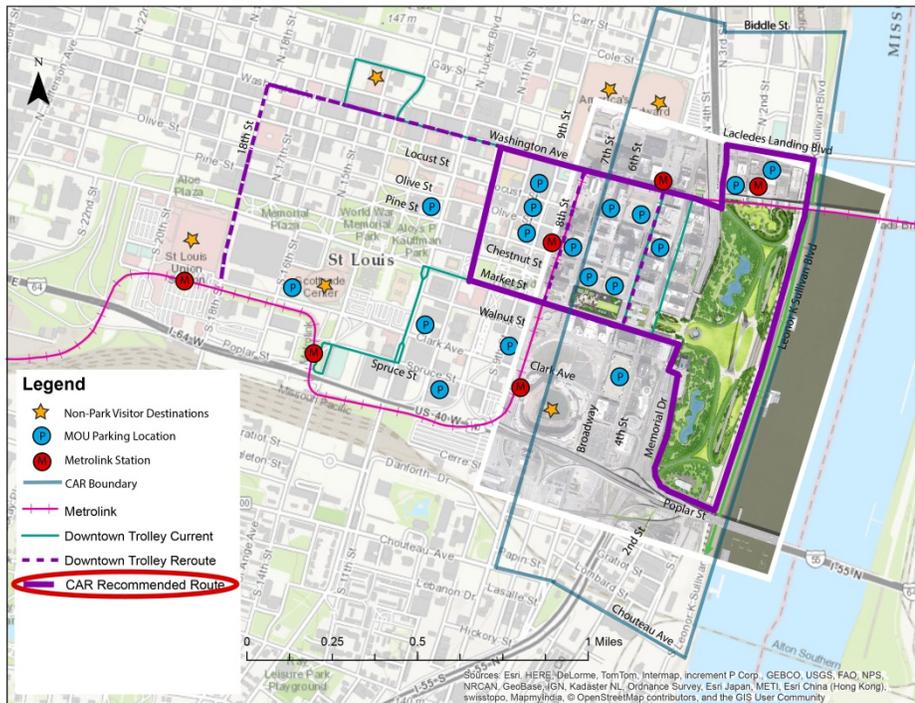
### *Circulator route layout and design*

Circulator routes provide service which is typically confined to a particular location in downtown or residential areas. Circulators connect to major activity centers and allow passengers to transfer to other routes to gain access to the rest of the network [and to other travel destinations]. They typically operate on a loop fashion, sometimes with only one-way directional service.

The proposed routing addresses user, operator and stakeholder needs. The circulator route would access multiple destinations and optimize convenience and connections within the CAR boundary and Downtown St. Louis. By providing visitors with a “window into the community,” it offers visitors with options and choices, the circulator could extend trip duration and thereby increase stakeholder opportunities.

**Figure 15 – City Arch River Recommended Route –**

Source: Volpe Center and November workshop



The Circulator would initially run as a one-way clockwise loop. Starting on Market street at the NPS Courthouse visitor center it would travel west to 11<sup>th</sup> Street, then north to Washington Avenue, east along Washington Avenue to Memorial Street, north along Memorial to Laclede’s Landing Blvd, east on Laclede’s Landing Blvd to LKS Blvd, south along the riverfront to Poplar Street, west on Poplar Street to Memorial Avenue northbound, and west along Market to the Courthouse visitor center. This route connects the park with the downtown area along Washington Avenue but could extend up to St. Louis Station to 20<sup>th</sup> to Washington and through the Chouteau district if warranted. The key to a successful route is the ability to flex during special events when some city streets are closed, and during times when flooding makes access to the riverfront impossible. This route could be combined with an extended downtown trolley route that could access primary employment centers west side of downtown. These employment centers could generate ridership, which in turn could generate business for venues located in the downtown/park and riverfront vicinity. This route is conceptual and will be refined during service planning.

During service planning, the following route attributes should be confirmed:

- That the proposed route is a distinct service that complements MetroLink and an improved Downtown Trolley reroute.
- That the circulator service provides convenient access to parking garages that serve the downtown as well as the park, particularly north of Market Street. Most of the garages are located on the north side of Market Street, and are within two city blocks of the Circulator route.
- That locating the route on 11<sup>th</sup> Street introduces visitors to additional Downtown St. Louis attractions and supports community economic goals. With limited operational cost increases, this routing increases transit opportunities in the 11<sup>th</sup> Street area. By extending service beyond the CAR boundary, additional ridership and destinations could increase stakeholder support and positive community outcomes.
- Seamless ticket exchange with METRO could allow transit “layering” to have broadest appeal to prospective riders and enable ridership growth for everyone - riders, service providers and the community.

### *Stop locations*

Circulator stops would be located within two or three short city blocks of most parking areas on the north side of the Gateway Mall, and at CAR destinations such as the Gateway Arch, riverfront and associated venues and events, and downtown St. Louis, thereby supporting CAR Partner goals.

Stops within Jefferson National Expansion Memorial Park vicinity:

- Old Courthouse
- Museum entrance
- North Gateway
- Eads Bridge/ Laclede’s Landing and MetroLink Station
- Central Riverfront
- North and South Overlooks

Stops within Downtown St. Louis:

Stops along the Gateway Mall, and the Washington and Olive Street Historic District could consist of the following:

- Ballpark Vicinity
- Gateway Mall / Kiener Plaza and Gateway Park
- Washington Street / Olive Street vicinity
- Convention Center Vicinity

- Parking Garages identified in MOU with NPS (at, or within 2 to 3 City Blocks)

Planning and design for circulator stops that are within the historic district or close to venues such as the Ballpark could be part of identity and branding efforts for downtown St. Louis streetscapes.

Extended service to provide seamless travel with Downtown Trolley or other transit routes in the vicinity:

- Union Station Include a segment to the Civic Center Station
- Clark St. for Ballpark Village
- Civic Center
- Include a segment off Broadway/4th to reach the bus drop off on Memorial.
- Jefferson Avenue stop could provide a connection for the 6000 employees at Wells Fargo.

### *Visitor Experience / Thematic Goals / Transit Market Potential*

The impetus for implementing the Circulator is “experience driven.” Though the Circulator route will complement existing transportation modes, it is primarily targeted at visitors and is intended to improve access to and promote a greater understanding of visitor opportunities in Downtown St Louis, at the Jefferson National Expansion Memorial Arch and museum, and along the riverfront.

First time JNEM visitors comprise 75 to 80 percent of NPS park visits. They typically arrive at the local parking garages and are encouraged to start their visit at the Courthouse Visitor Center, travel to the Arch and Arch Museum (where dwell time is anticipated at 1-2 hours (confirm), then to the Riverfront and return. The circulator can collect many of these visitors and transport them to the Courthouse visitor center. The circulator should be a fun, engaging platform to facilitate touring, assist wayfinding and introduce downtown St. Louis.

Transit market potential could be derived from:

- Park visitors who want to spend more time in the city
- St. Louisans who are downtown for other purposes and want to broaden their agenda. Many visitors are local residents who make a trip downtown to attend a venue or special events (81 days the year) such as a baseball game and then decide to combine their primary reason for travel with a visit to the Arch grounds. The circulator can facilitate these trips.
- Convention participants expanding their daily activities to include the Gateway Arch and riverfront environs
- Employees who may want to use the circulator to facilitate a trip to the Arch or Riverfront. The local and visiting workforce could use the circulator to reduce travel time from their offices to and/or from the Gateway Mall, the Arch grounds and the Riverfront.

## *Trip planning, orientation and wayfinding*

Information regarding the circulator would be provided on park and Downtown St Louis travel oriented websites. For those who are spontaneous visitors, orientation and wayfinding information would also be provided at the primary and secondary transit hubs, such as at the airport, MetroLink Stations and at downtown arrival destinations, such as the parking garages, convention center, ball park and football stadiums, and hotels. This information would inform visitors and residents about the circulator service and how to access and use it to facilitate their travel experience. Wayfinding aboard the Circulator would include routing information and would also orient visitors to City, Arch and River, and encourage them to extend their stay or return again to experience other venues offered in the area. This information could include use of the interior panel displays as well as offer virtual information via mobile trip planning applications.

Branding to “name” the Circulator and “wrap” the buses would be part of a larger implementation effort. The circulator should be recognizable and distinguished from other tourism based services operating with in the downtown area. It should complement these services and not compete with them.

## *Accessibility*

Route location is influenced by geographical conditions (vertical separation from the Mississippi Riverfront, City and Arch grounds, trip generators and attractors such as planned events and greenway access points along the riverfront, and generally acceptable walking distance. Walking distance that is acceptable on a sunny pleasantly warm day is typically  $\frac{1}{4}$  to  $\frac{1}{2}$  mile, but can be considerably less in a sweltering heat, extreme cold, or rain, as well as for persons with disabilities.

The creation of a Circulator loop combines walkability with transit oriented development. It extends what is typically a comfortable quarter mile (5 minute walk,) which is achievable by most visitors, and provides an accessible route to most attractions for persons with disabilities. Families who travel with small children or family members with physical disabilities would be able to use the circulator to facilitate travel as a group.

One loop is easy to understand, operate and explain. An advantage to providing one loop route that stops at key destinations in the Park and Downtown St. Louis is that, once aboard the bus, transfers are unnecessary. Transfers between routes can also be time consuming and difficult for persons with disabilities.

Laclede’s Landing and riverfront access for persons with disabilities is difficult due to the ubiquitous presence of cobbled streets. Accessing these areas with the circulator will shorten the cobbled distance that needs to be traveled.

The circulator system could link with other modes of transit, thereby providing seamless connections with other transit options such as the Downtown Trolley, Metro light rail line and looking to the future, the St. Louis Streetcar.

The vertical separation and grades required to move from the riverfront to the courthouse can be challenging to anyone at the end of a long hot day’s visit. The Circulator would

provide assistance with getting passengers to and from the riverfront (climbing the hill), particularly at the end of special events.

### *Service availability*

Service availability relates to the passenger's ability to access and use the circulator. Stops would be located within a two to three block distance of primary parking garages on the north side of the Gateway Mall and many hotels, the circulator, couple with other transit such as Metrolink, the Downtown trolley route, and the future St. Louis Trolley, could enable car free travel around much of Downtown St. Louis, and within the CAR boundary. The Circulator would provide easy access and momentum for riverfront events, even with fixed capacity in terms of demand.

### *Marketing*

To assist in the startup and continued success of circulator operations, marketing activities will be critical to create and sustain customer awareness, service refinements and long term viability. Marketing activities will provide pre-trip, in trip and post trip assistance varying from website information, branding and advertising, and service design to social media applications.

Marketing activities could assist ridership generation and/or revenue contributions through bundling circulator service with park entrance fees, convention center ticketing, hotel complimentary services, Metro transit system ticketing and parking ticketing. This could provide incentives to use the shuttle as well as support system operations.

### *Business Model*

With general agreement on the proposal for circulator service, CAR could lead and champion organizational support from partner agencies to assist in planning, implementation and system operations preparations. In lieu of separate organizations and contracting challenges, it is recommended to utilize CAR support and endorsement to engage Bi-State Development Agency (BSDA), an existing regional organization responsible for economic development and transportation. "BSDA was created to serve the region on both sides of the Mississippi - to have a regional outlook not tied to any one municipality, county or state. As such, it was given broad powers that enable it to cross local, county and state boundaries to enhance the development of the region [and] to improve the region's quality of life by providing excellent transportation and promoting economic development."<sup>5</sup>

## **Conceptual Operations**

Using the post workshop recommendation as a base, the study team developed a general operations description. The description assumes the large CAR loop is used and operated throughout the year and the demand for service is about 452,000 riders per year. The duration of time between buses (headways) should be based on the visitation season. July has the shortest headways of 5 minutes between buses to accommodate the significant influx of visitors. June and August, which are also peak visitation months, should function

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<sup>5</sup> Website <http://www.metrostlouis.org/About/History.aspx>

well with 10 minute headways. Ridership is expected to drop off significantly in the shoulder and off-peak seasons and only 15 minute headways should be needed. Service in the slowest Winter months could be reduced further to only run during the busiest times of day.

**Table 1**  
**Conceptual Operational Details for One Circulator Loop**

Source: Volpe Center

<b>Scenario 1 – Full Year Service</b>			
	<b>Peak of Peak July</b>	<b>Peak June &amp; August</b>	<b>Shoulder/Off-Peak September - May</b>
20% of Visitation	156,000	102,000	219,000
Estimated <b>Total</b> Ridership*	105,000	102,000	215,000
Proposed Headways	5 minutes	10 minutes	15 minutes
Trips Per Vehicle Per Hour	4	3	2
Vehicles To Fulfill Service Needs	4	2	2
Total Fleet Needed**	4-5	3	3
<b>Scenario 2 – March-October Service</b>			
Estimated Total Ridership	105,000	102,000	155,000

\*Estimated ridership is based either on 20% of visitation or maximum transit capacity by month, whichever is lower; visitation is estimated to exceed transit capacity for the months of May and July

\*\*Total fleet needed includes one back up vehicle for the Peak and Off-Peak scenarios;

The total fleet required for operations under the conceptual scenarios ranges from 3-5 with a recommendation for 3. Operating with 3 vehicles in the fleet provides an appropriate spare ratio<sup>6</sup> as well as needed capacity for the July peak season while keeping procurement and fueling costs low. It is assumed an additional 1-2 vehicles could be borrowed or leased/rented to cover the additional demand for the month of July. Additional information on procurement and fueling costs are in a later section.

### *Estimated Operating Costs*

The estimated operating costs shown in Table 2 are based on the conceptual operations described above for the circulator loop and a base vehicle price of \$350,000. (Vehicles options are detailed in the next section) The study team also assumed there would be some new maintenance and infrastructure requirements for the service.

<sup>6</sup> The Federal Transit Administration defines spare ratio as “the number of spare vehicles divided by the vehicles required for annual maximum service.” “Vehicles operated in maximum service” is defined as the total number of revenue vehicles operated to meet the annual maximum service requirement. A 20% spare ratio is a typical guideline for transit providers. ([http://www.fta.dot.gov/legislation\\_law/12349\\_4114.html](http://www.fta.dot.gov/legislation_law/12349_4114.html))

**Table 2**  
**Estimated Operating Costs Over 12 Years**

Source: Volpe Center

<b>Scenario 1 – Full Year Service</b>		
<b>Category</b>	<b>Notes</b>	<b>Estimated Costs</b>
Capital Costs	2 vehicles (base operations)	\$700,000
	1 vehicle (spare ratio/peak)	\$350,000
	Capital Subtotal	\$1,050,000
Maintenance & Infrastructure*	Estimated new needs	\$300,000
Operations	2% inflation	\$16,500,000
Vehicle Replacement (12 years)	Assumes 20% inflation	\$1,300,000
<b>TOTAL 12 YEAR COSTS</b>		<b>\$19,150,000</b>
Cost Per Year of the 12 Years	Simple breakdown by 12 years	~\$1,595,000
Cost Per Rider	Assumes 422,000 riders/year	~\$3.80
<b>Scenario 2 – March-October Service</b>		
<b>Category</b>	<b>Notes</b>	<b>Estimated Costs</b>
Capital Costs	2 vehicles (base operations)	\$700,000
	1 vehicles (spare ratio/peak)	\$350,000
	Capital Subtotal	\$1,050,000
Maintenance & Infrastructure*	Estimated new needs	\$300,000
Operations	\$1,200,000 per year for 12 years	\$12,000,000
Vehicle Replacement (12 years)	Assumes 20% inflation	\$1,300,000
<b>TOTAL 12 YEAR COSTS</b>		<b>\$14,600,000</b>
Cost Per Year of the 12 Years	Simple breakdown by 12 years	~\$1,217,000
Cost Per Rider	Assumes 360,000 riders/year	~\$3.40

\* Reflects estimated maintenance and infrastructure costs for electric vehicles. Diesel vehicles would be less; CNG vehicles would be about \$600,000

One additional cost incorporated into the overall cost of the system is the capital replacement cost for vehicles in approximately 12 years, the anticipated useful life for the vehicles. Park units across the service with active transit systems are grappling with how to pay for the vehicle replacements costs as vehicles come up to the end of their useful life. The analysis in Table 2 incorporates these costs as an additional component in the initial 12 years of service as a way to ensure JEFF's ability to replace vehicles when they are needed. Park management and partners may decide they will identify grants or other means of paying for the vehicles, which would reduce the cost per rider significantly (less than \$3.00 per passenger). However, the analysis in Table 2 is intended to be a more complete accounting for the service as the park and its partners to consider as they determine their next steps.

## Fleet Vehicle Options

This section includes a set of vehicle options developed in advance of the November 2014 workshop. These selections remain relevant for the recommendation of the CAR large loop recommendation of this report.

A 30-foot, flat-front, transit style bus is a preferred vehicle for similar service throughout the National Park Service as larger buses are not able to navigate the close confines and small roads or parking areas typically found within NPS lands. Previous trials with other body types such as a “cutaway” style shuttle-buses revealed their body design limits the views of occupants, and such chassis are typically built on a lighter-duty platform yielding a shorter expected vehicle life. Therefore for this analysis, medium-sized “transit style,” flat-front buses were examined.

A summary of the available replacement vehicles considered is shown in Table 3.

**Table 3**  
**Flat front transit buses considered**

Source: Volpe Center

	<b>El Dorado E-Z Rider II</b>	<b>Gillig 29' BRT</b>	<b>New Flyer Midi</b>	<b>Ebus 22' battery-electric</b>
Cost	\$310,000-\$350,000	\$330,000-\$375,000	\$300,000-\$340,000	\$395,000
Passengers	Up to 33	Up to 28	Up to 27	Up to 22
Body Height	126" (Diesel)	122" (Diesel)	121"	110"
Body Width	102"	102"	96"	92"
Wheelbase	160"	160"	163"	147.4"
Turning Radius	26'-6" curb to curb	29'-3" outside bumper	27'-11" outside bumper	28'
GVWR*	35,000 lbs.	n/a	19,400 lbs. (curb weight)	20,500 lbs.
Range	300+ miles	300+ miles	300+ miles	Up to 125 miles

\*GVWR - Gross Vehicle Weight Rating

## *El Dorado E-Z Rider II*

(<http://www.enconline.com/CAproducts.cfm>)

The El Dorado E-Z Rider II is a twelve (12) year, 500,000 mile Altoona-tested vehicle. Of the available equivalent vehicles, El Dorado has an intimate knowledge of park-specific needs and parks that have operated their buses have been pleased with the build quality, fit and finish, reliability and performance. The E-Z Rider II is recommended as a preferred vehicle option for the potential vehicle fleet.

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### **Figure 16 - El Dorado E-Z Rider II**

Source: (<http://www.creativEbussales.com/images/alternative-fuels/cng-alt-fuels-buses/transit/EZRiderII-cng-vehicle.jpg>)



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#### Relevant specifications

Cost: \$310,000-\$350,000 dependent upon options fitted

    CNG option adds \$55,000 per vehicle

    Hybrid electric option adds \$230,000 per vehicle

Body Height: 126" (diesel and hybrid-diesel), 135.5" (CNG)

Body Width: 102"; Wheelbase: 160"

Seating: up to 33, or 25 with 2 wheelchairs

Turning Radius (Curb to Curb): 26'-6"

## Gillig 29' Low Floor BRT

(<http://www.gillig.com/#!brt/c1752>)

The Gillig 29' Low Floor BRT is a current model within the Gillig bus lineup and the only Gillig model available in a ~30' platform. It is a twelve (12) year, 500,000 mile Altoona-tested vehicle. The Gillig 29' Low Floor BRT is an acceptable option for vehicle replacement, but is not a preferred option due to its higher price. A potential advantage of the Gillig among equivalent replacement buses is a slightly lower maximum vehicle height of 122" for diesel and 132.1" for CNG, which is 3" lower in maximum height compared to the E-Z Rider II.

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### Figure 17 - Gillig 29' Low Floor BRT

Source:

[http://static.wixstatic.com/media/df7719\\_88db5b7617894878bd854d8feb824e69.jpg\\_srz\\_p\\_530\\_200\\_75\\_22\\_0.50\\_1.20\\_0.00.jpg\\_srz](http://static.wixstatic.com/media/df7719_88db5b7617894878bd854d8feb824e69.jpg_srz_p_530_200_75_22_0.50_1.20_0.00.jpg_srz)



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#### Relevant specifications

Cost: \$400,000 with popular options fitted

    CNG option adds \$55,000 per vehicle

    Hybrid electric option adds \$180,000-\$200,000 per vehicle

Body Height: 122" (diesel), 131.9" hybrid-diesel) and 132.1" (CNG)

Body Width: 102"; Wheelbase: 160"

Seating: up to 28

Turning Radius (Outside Bumper): 29'-3"

## *New Flyer MiDi 30'*

(<http://www.newflyer.com/index/midi>)

The New Flyer MiDi 30' is an affordable equivalent vehicle replacement option priced around \$320,000 depending on optional equipment. It is a twelve (12) year, 500,000 mile Altoona tested vehicle. New Flyer has not been licensed to provide anything but a clean diesel version of the Midi. The MiDi is the most low-profile option in both height and body width among the traditionally fueled options and has one of the smaller turning radiuses in the class as well. If maneuverability and size are prioritized over fuel choice, the MiDi may be considered.

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### **Figure 18 - New Flyer MiDi 30'**

Source: [http://www.newflyer.com/pix/News%20Center/Bus%20Pictures/Midi/midi\\_02.jpg](http://www.newflyer.com/pix/News%20Center/Bus%20Pictures/Midi/midi_02.jpg)



#### Relevant specifications

Cost: \$320,000 with popular options fitted

No CNG or hybrid-electric options available

Body Height: 121"

Body Width: 96"; Wheelbase: 163"

Seating: up to 27

Turning Radius (Outside Bumper): 27'-11"

## *Ebus 22' Battery-Electric, Zero Emission Transit Bus*

(<http://Ebus.com/22footelectricbus.html>)

The Ebus 22' Electric Bus is a 22' battery-electric bus with a range of up to 125 miles. The buses would fit in a seven (7) year, 100,000 mile category; although their 22' Ebus has not been Altoona tested, a 22' Ebus trolley has,<sup>7</sup> performing with no drivetrain failures. The 22' Ebus has been deployed in revenue service for over a decade, where they have exhibited reliable performance and positive visitor acceptance. The 22' Ebus has lower passenger capacity compared to the replacement vehicles noted above; however, it is the cleanest, most low-profile and maneuverable option presented.

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### **Figure 19 - Ebus 22' Battery-Electric Transit Bus**

Source: [http://Ebus.com/images/556\\_Ebus\\_22\\_ft\\_A.jpg](http://Ebus.com/images/556_Ebus_22_ft_A.jpg)



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#### Relevant specifications

Cost: \$395,000

Body Height: 110"

Body Width: 92"; Wheelbase: 147.4"

Seating: 22 passengers

Turning Radius (Curb to Curb): 28'

GVWR: 20,500 lbs.

Maximum Speed: 45 mph

Gradeability: Up to 15 percent

Range: Up to 125 miles on batteries (slow charge), up to 30 miles (w/ fast charge), range can be extended with optional fuel cell systems.

Energy Efficiency: 0.7-1.4 kWh/Mile (gross DC)

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<sup>7</sup> Altoona Bus Testing, Ebus 22T Testing Report, available at:

<http://146.186.225.57/buses/166>

## Replacement analysis

### *Vehicle capital costs*

Costs for specific vehicles will depend on the manufacturer, fuel type and options chosen during final vehicle selection. The analysis below assumes the following costs on a basis of fuel source.

- 30' Generic diesel bus costs \$350,000
- 30' CNG-powered bus costs \$405,000
- 22' battery-electric bus costs \$395,000

The cost to procure buses for a new fleet breaks down as follows:

- Fleet (3 buses) with diesel buses: \$1.05 million
- Fleet (3 buses) with CNG buses: \$1.215 million
- Fleet (3 buses) with 22' battery-electric buses: \$1.185 million

Diesel-hybrid buses were not considered for this report as their significant cost would be hard to recapitalize without significantly more miles traveled by the fleet.

### *Fueling operational costs*

The fleet is anticipated to cover roughly 90,000 miles per year (combined) which, if spread across 3 vehicles in the fleet would result in annual mileage of around 30,000 miles per vehicle assuming vehicles are rotated among routes and in and out of service equally.

The resultant costs to fuel a 3-vehicle fleet for each fuel type considered are:

- Annual fueling cost for 3 diesel-powered buses: \$57,000
- Annual fueling cost for 3 CNG-powered buses: \$40,000
- Annual charging cost for 3 battery-electric buses: \$11,000

JEFF has not identified a local CNG provider, and a diesel gallon equivalent (DGE) cost for CNG at the time of this report was unavailable; however, calculations were made with an assumed fuel cost of \$2.20 per DGE for CNG. JEFF indicated a former CNG-fueling station has been decommissioned and there is no current CNG fueling option on-site. The national average diesel price of \$3.14/gallon<sup>8</sup> as of January 2015 was used for diesel cost calculations.

The U.S. Energy Information Administration (EIA)'s 2011 Energy Outlook forecasts the cost for diesel fuel will rise at 5% per year, while the cost of CNG will rise at a slower 3% per year. Electricity is assumed to rise at a similar 3% inflation rate. Electricity has been converted to eGallon<sup>9</sup> for the state of Missouri, with an assumed efficiency for the Ebus of 10 miles per eGallon.

An analysis of potential fleet purchase and fueling costs was performed based on the above cost factors and EIA's predictions for the inflation rate of 3% for CNG, 5% for diesel and

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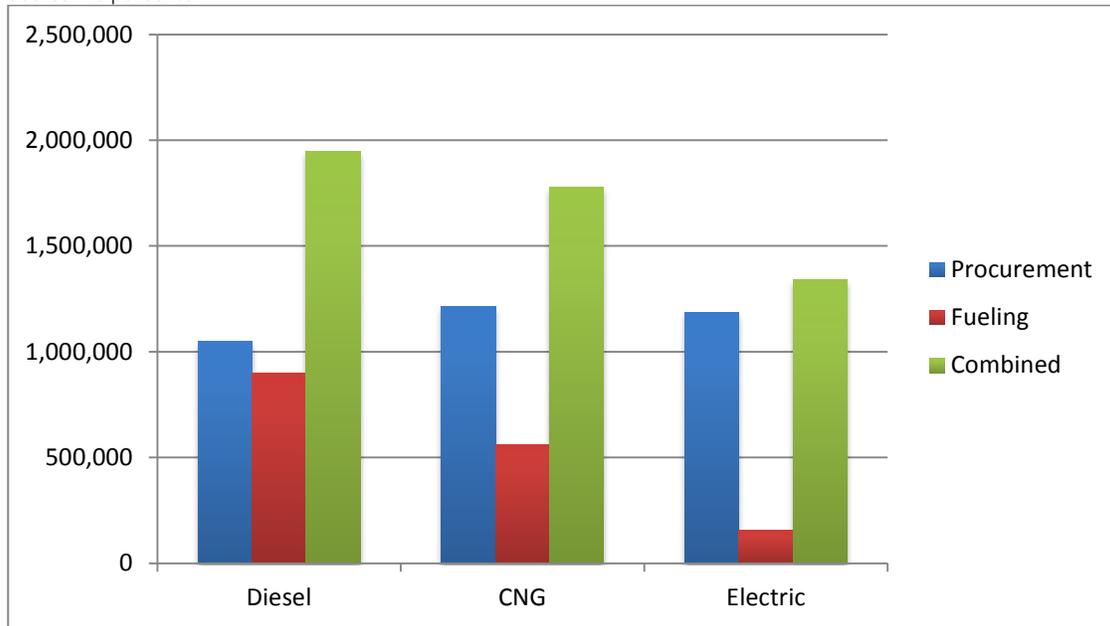
<sup>8</sup> Weekly Retail Diesel Price, Midwestern United States, U.S. Energy Information Administration, from [http://www.eia.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_r20\\_w.htm](http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r20_w.htm)

<sup>9</sup> eGallon cost for the State of Missouri, from <http://energy.gov/articles/egallon-how-much-cheaper-it-drive-electricity#>

assuming electricity will rise at a 3% rate. The costs to procure the fleet, fuel the fleet and the total costs of purchase and fueling are shown in Figure 20 below.

**Figure 20 - Fleet purchase and fueling costs EIA inflation**

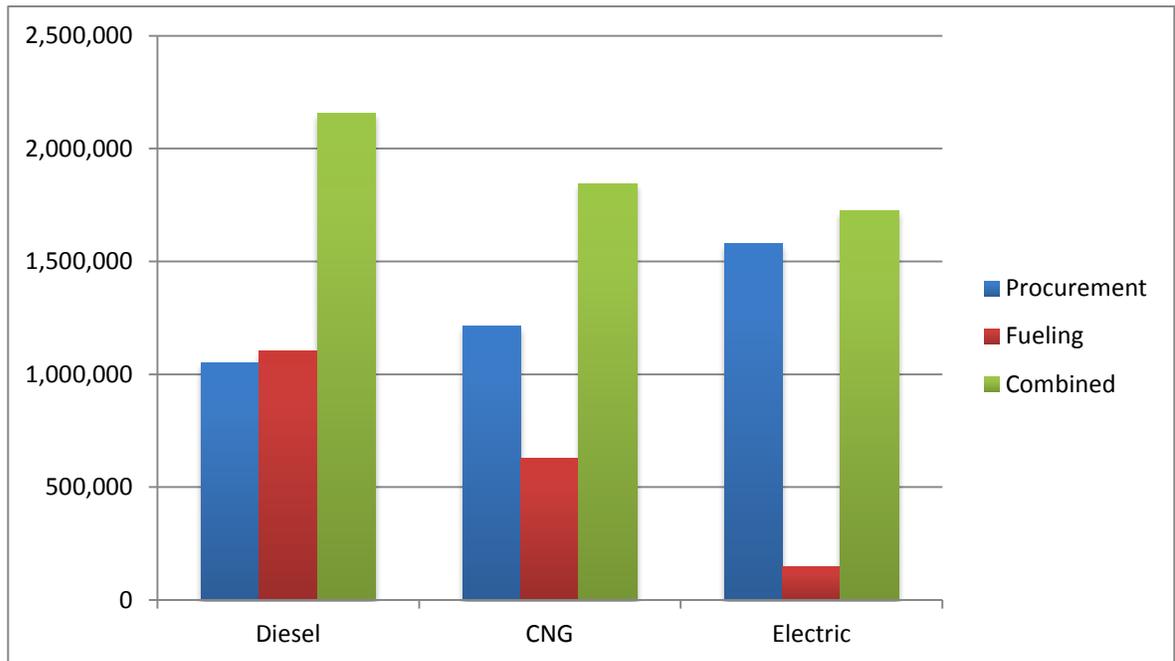
Source: Volpe Center



Historical costs from the past 20 years indicate a higher inflation experienced by diesel of 8.5% and a lower inflation experienced by electricity of 1.9%. A scenario that explores these inflation rates and a higher inflation rate for CNG of 5% is shown in Figure 21 below.

**Figure 21 - Fleet purchase and fueling costs, 20-year historical inflation**

Source: Volpe Center



### *Purchase and fueling cost summary*

Both fuel inflation scenarios above result in slightly different costs to fuel the fleet. In both instances, the total combined cost of fleet purchase and fueling is lowest for battery-electric buses. However, it should be noted that the battery-electric buses are the lowest capacity option and may require additional vehicles to fulfill peak demand.

### *Maintenance costs*

Studies of latest generation clean diesels and CNG buses show maintenance costs are nearly identical, with neither fuel type presenting a significant advantage or disadvantage. Proponents of battery-electric buses cite their fewer parts and lesser need for brake maintenance due to regenerative braking and energy recapture; however, Santa Barbara Metropolitan Transit District operate 22' battery-electric eBuses and accrue maintenance costs in-line or slightly higher than typical maintenance costs of diesel buses, when battery replacement and proprietary (more expensive) replacement parts are factored in. It should be noted that the high costs they are currently experiencing to maintain their vehicles can also be attributed to the age of their fleet, with the newest bus in operation having been manufactured in 2003. Due to the uncertainty of maintenance costs with electric buses, they are presumed to incur equivalent costs for this analysis. It should be noted that as battery-powered bus technology improves, significantly reduced purchase and maintenance costs are anticipated.

There are other capital cost considerations, including fuel storage and dispensing and maintenance facilities. This level of analysis will should be completed during later stages of

assessment when the park or partner agencies are ready to pursue vehicle selection for a specific route.

### *Lifecycle cost summary*

Costs associated with procuring and fueling, the fleet for 12-years is summarized below.

**Table 4 Total Lifetime Costs - Purchase, Fueling and Maintenance (2013 dollars, EIA inflation)**

Source: Volpe Center

	<b>Diesel</b>	<b>CNG</b>	<b>Battery Electric</b>
Capital Costs	\$1,050,000	\$1,215,000	\$1,185,000
Lifetime Fuel Costs	\$899,000	\$562,000	\$156,000
<b>Purchase and Fueling 12-Year Total</b>	<b>\$1,949,000</b>	<b>\$1,777,000</b>	<b>\$1,341,000</b>

An all-electric fleet would cost slightly more than a diesel fleet and slightly less than a CNG fleet to procure but significantly less than either diesel or CNG to fuel. An electric fleet would save between **\$440,000** and **\$610,000** compared to a CNG or diesel fleet based on EIA commodity inflation projections. Based on historical projections with a higher 8.5% rate for diesel, a 5% rate for CNG and a lower 1.9% inflation rate for electricity; an all-electric fleet could save between **\$514,000** and **\$824,000** compared to a CNG or diesel fleet.

The substantial long-range cost savings for all-electric vehicles due to extremely low fueling costs could enable the park and its partners to consider an additional vehicle (4 all-electric vehicle buses). A fourth vehicle in the fleet would enable the operator to better cover July demand without borrowing or renting vehicles and would also allow the operator to distribute wear on the vehicles more evenly. Under a scenario of 4 all-electric buses compared to 3 diesel or CNG buses, a larger all-electric fleet could still save between **\$119,000** and **\$429,000** compared to a CNG or diesel fleet respectively using the higher inflation rates (although this does not include additional labor rates for operating an additional vehicle).

### *Environmental considerations*

Both current generation clean diesel and CNG buses will provide emissions benefits, particularly all new buses meeting stricter emissions standards. Overall “wells-to-wheels” greenhouse gas (GHG) emissions from current CNG buses are roughly 5% less than from new clean diesel buses. Tail-pipe CO<sub>2</sub> emissions from CNG buses are roughly 22% lower per diesel-equivalent gallon than those emitted by clean diesel buses, however the latter is offset by CNG’s higher fuel consumption.<sup>10</sup> Generally speaking, CNG buses may offer slight

<sup>10</sup> Memo from Dana Lowell of MJ Bradley and Associates to Conrad Schneider of the Clean Air Task Force, summarizing the results of a “Comparison of Modern CNG, Diesel and Diesel Hybrid-Electric Transit Buses: Efficiency & Environmental Performance.” Memo: [http://www.catf.us/resources/publications/files/20120227-Diesel\\_vs\\_CNG\\_FINAL\\_MJBA.pdf](http://www.catf.us/resources/publications/files/20120227-Diesel_vs_CNG_FINAL_MJBA.pdf) Report: <http://mjbradley.com/sites/default/files/CNG%20Diesel%20Hybrid%20Comparison%20FINAL%2005nov13.pdf>

benefits in terms of certain tailpipe emissions such as Black Carbon (BC, or soot), Particulate Matter (PM) and Hydro Carbon (HC). Diesel buses may provide lower Carbon Monoxide (CO) and methane emissions (CH<sub>4</sub>) both at the tail pipe and particularly upstream (from energy production and delivery).

Electric vehicles have no tail pipe emissions, although the source of electricity should factor into any environmental justifications for vehicles requiring electricity to recharge.

## Vehicle Recommendation

All vehicle and fueling options presented within this report are acceptable options for a fleet in terms of providing clean, efficient and reliable transportation. A diesel-powered fleet would integrate well to an already diesel-powered fleet and latest generation diesel buses are cleaner and more efficient than ever before. A CNG-powered fleet would require fueling infrastructure and other significant capital expenditures if no facilities exist to maintain or fuel a CNG fleet. CNG can however, provide benefits such as reduced emissions and significantly reduced fueling costs. A battery-electric fleet holds potential to provide zero emissions transportation on a tested and in-service proven platform which compares favorably to other technologies in terms of reliability and maintainability. An all-electric fleet could achieve substantial cost savings over the life of the vehicles, even if batteries must be replaced. However, even if cost-savings are not realized, in-service electric buses have garnered positive feedback from visitors and drivers alike while providing substantial reductions in both noise and emissions.

A battery-electric fleet is recommended for strong consideration for service; however, the successful implementation requires stakeholders to be engaged and the operating authority trained on operation and maintenance of new technology vehicles.

## Funding Feasibility

With full year service, capital costs of the Circulator vehicles are \$1.05 million; maintenance and infrastructure improvements are \$300,000, annual operating costs are \$1.6 million and \$1.3 million for vehicle replacement after 12 years (FY 2015 costs). Funding for these investments and operations will require close coordination for local, regional, state and federal support. Total cost of ownership based upon 12 years of capital and operational expenditures is estimated to be \$19.15 million, with \$16.5 million of that amount attributed to operations.

With strong local support, a varied source of grants, local annual budgeting, district assessments, and fare box donations could provide a sustainable source of funding. In many cases funding from federal sources is distributed to State, regional, and local governments by formula, and then suballocated to providers of transit services.

Specifically, FTA and FHWA grant programs may provide funding opportunities for capital investments.

### FTA Programs

- Bus and bus facilities formula grants (\$5339)
- Urbanized area formula grants (\$5307)
- Formula grants for the enhanced mobility of seniors and individuals with disabilities (\$5310)

#### **FHWA Programs**

- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Federal Lands Access Program (FLAP)
- Federal Lands Transportation Program (FLTP)
- Surface Transportation Program (STP)

For transit operational funding a variety of local sources may be considered. These local sources which may be considered for matching funding purposes, could utilize business improvement district assessments, fare box donations, and MOU negotiated allocations for parking surcharge fees to support transit operations. In addition, Bi-State Development Agency ticketing could offer a bundled ticket allowing passenger to ride the circulator and contribute to the circulator's operational cost structure. For NPS Special events in which fees are assessed, conditional use authorizations (CUA's) may be able to generate supplemental operational revenues as per agency policies.

The proposed circulator recommendation requires significant capital and operational funding. Partnering at a federal and state level will be required for system start-up. Additional partnering for operational fund sources and determining a minimum threshold of rider revenue contributions is recommended. The circulator feasibility may be dependent upon financial partnering and operational cost recovery outcomes.

## **Next Steps**

The following task outline allows stakeholders to confirm circulator support, pilot opportunities, complete planning and decision making, and take steps towards securing funding, implementation, and operations subsequent to CAR improvements. Dependent on project champion support and funding opportunities, this task outline will allow stakeholders to advance study recommendations in phased actions towards implementation. Identification of the task leadership requirements will be critical to successful next steps. Schedules could be compressed dependent upon service planning and selected operator strategies.

#### **2015-2016 *Energize***

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Following feasibility study submission, review and support of recommendations, the CAR partnership could:

- Seek civic engagement input with communities of interest,
- Seek input from City/Region/State/ Federal Transportation Community,
- Identify mini Pilot opportunities for 2 week circulator test operation with school buses and social media feedback for service opportunities and community involvement,

- Develop preliminary funding strategies for planning, acquisitions, operations, infrastructure, maintenance and fleet replacement,
- City Arch River Partnership incorporates input, confirms circulator service support, establishes an action plan for service planning, and identifies project leadership and champions,
- Secure funding for service planning.

### 2016-2018 *Refine*

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Initiate final transportation service planning tasks:

- Confirm market demand,
- Develop public involvement plan and public input,
- Finalize implementation service alternative/alternatives for acquisition, operations, infrastructure, and implementation,
- Determine service contracting requirements,
- Develop financial pro formas for revenue and expense requirements, including all business expenses – marketing, branding, donation and farebox strategies etc.,
- Update financial planning strategies - acquisition, operations, infrastructure, maintenance, and replacement,
- Complete appropriate federal and state compliance requirements,
- Conduct agency consultation,
- Prepare decision documents,
- Secure agency commitments and approvals for implementation,
- Memorandums of Agreements with partnering organizations.

### 2018-2020 *Prepare*

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Initiate implementation tasks:

- Seek capital for vehicle acquisition, infrastructure and service operations, as needed,
- Finalize revenue and expense projections for operations and maintenance requirements, responsibilities and operational agreements,
- Conduct service contracting as needed,
- Implement infrastructure procurements - operational, streetscape, circulator stops and wayfinding facilities and improvements,
- Procure vehicles as needed,
- Develop marketing plans and finalize implementation requirements.

### 2021 *Implement*

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Initiate service preparations and startup operations:

- Initiate marketing and public promotional campaigns,
- Initiate circulator service operations, maintenance and service management.

## Appendix

### *Appendix A - Information / Comments / Questions Collected during Workshop*

1. Add labels for Soldiers Memorial and the Central Library Branch on route maps.
2. Consider solar charging capability for vehicles.
3. A BIG assumption is that the Downtown Trolley route can change. Confirm trolley reroute for 2015.
4. The Forest Park Trolley runs April weekends, seven days a week in May. Headways on weekends are 15 minutes and it runs through September and the service. Stops on October 15.
5. Consider how to sustain revenues in the winter when tugs cannot run or lose ridership.
6. During baseball games Clark is closed down from Broadway to 8<sup>th</sup> St.
7. Need to complete a life cycle cost analysis to compare alternatives and to consider total cost of operation
8. Where would vehicles be stored? There is no current facility for light vehicle storage. They would need to be stored outside of the Park.
9. What are fuel storage needs? Consider electric vehicles.
10. Confirm counting assumptions regarding visitation data. Look at Brian's survey data to compare with NPS data to help determine ridership demand. NPS counts at the Courthouse, Arch, Museum and tram. There is also a need to understand why certain visitors do not come to the park.
11. What method will be used to project growth in visitation?

#### Post Workshop Comments

1. Concern that there is not enough funding for an Arch Circulator. Depending on the level of financial support from the NPS and/or CAR, people wonder where the funds will be found.
2. The two main options for a route/service from the workshop are very different, but could be complementary. The Tram option is focused on tourists taking them from the Arch grounds to Kiener. While the Downtown Loop route could gain ridership from tourists, workers and residents, it will fulfill the connection of Arch people to the parking garages.
3. Downtown Loop route does not serve as an improved Metro Downtown Trolley Bus. I do not see an additional/separate service that would work with the Downtown Trolley Bus. I think we can take the Trolley Bus and meet a lot of the needs for the NPS.
4. Ways to improve the Downtown Trolley Bus to help circulation for the NPS:
  - a. Two way loop route.
  - b. Basic loop route would be Jefferson Ave., Washington Ave., Broadway/4<sup>th</sup> St., and Market St.

- i. Include a segment to the Civic Center Station.
- ii. Include a segment down to Clark St. for Ballpark Village.
- iii. Include a segment off of Broadway/4<sup>th</sup> to reach the bus drop off on Memorial.
- iv. Include a Laclede's Landing connection to 3<sup>rd</sup> St.
- v. With Jefferson Ave., this connects the 6000 employees at Wells Fargo.
- vi. Option: seasonally run an extra one way loop on Leonor K Sullivan Blvd. – The Tram option could eliminate this need.

5. Support electric buses as a recommended vehicle.

6. Clarify fare-box “donation” and restrictions associated with some of the funding. Consider starting off with kick-off rate of \$1 per ride, or \$8 all day, take cash, or credit card (initiate metro card) – on credit cards, no need to worry about authorizing each transaction, just store and bulk load them.

7. Consider if there is a substantial need for transit in downtown unrelated to the arch visitor, in terms of demand, that might significantly overlap with the needs of Arch visitor and, if addressed in concert, might make for a much better more sustainable system overall. In other words, if one makes the problem slightly bigger, one might have a much bigger pool of financial resources to make the whole system work.

8. If the goal were to make every major destination in downtown easily accessible by transit, consider making a big impact on actually making downtown more vibrant and offering a much better experience to all of downtown stakeholders and visitors. Meaning one finally gets to the point where you park once and can get anywhere – with the goal to stretch from this proposal.

9. Drop barriers to entry as much as possible:

- Simple is better – ideally the route and destinations are so simple a rider can absorb them at a glance, without having to consult route maps and schedules
- Marketing, marketing, marketing – meaning understand who the customer is and make them feel like this is for them – everything from graphics on the exterior of the bus, to interior design, to bus stop design. If it is unique and cool, social media will do your advertising.
- GPS based system tied to an application, so a customer knows where the bus she/he wants is and how long before it gets to her/him.
- Most important, at least initially, it should not be run by metro. Metro is one of the best, if not the best, metro transit agencies in the country from the perspective of an efficient delivery of service, but their mission is provide transit to folks who don't have an option. The mission here is different and it needs to be incubated outside of the metro system – with the thought that maybe, in the future, metro might absorb it.
- Hospitality – the drivers and the whole experience needs to be geared towards hospitality – another reason not to use Metro, at least initially, and try and avoid a union, again, at least initially.

10. Route Structure Suggestions - One way to think about this might be to divide the routes into really simple segments:

### **Stadium Link**

This is just 7<sup>th</sup> Street, back and forth between the Dome and Busch Stadium – within two blocks of that route are:

· Over 1,000 residential units; Over 1 million SF of commercial office; Something like 5,000 parking spaces; Convention Center; Dome; Busch Stadium; Gateway Mall/City Garden; Kiener Plaza; Ballpark Village; MX – restaurants/movie theater; Over 2000 hotel rooms; Two Metrolink stops

Think of under 10 min headways on that route with 1 bus. It is about ½ mile from end to end. There is a turnaround at 7<sup>th</sup>/Convention and probably use the BPV parking lot to turn around on the south end. It would require making 7<sup>th</sup> St 2-way. Route might be year-round, and something like 7 am to midnight.

This route could drive enough sponsorship/traffic that it might help the other routes.

### **Downtown Circle**

The next route might be a simple circle - Washington to 14<sup>th</sup> to Clark (maybe Market instead) to Broadway/4<sup>th</sup> to Washington – going in both directions.

That route would connect every hotel in downtown to the convention center, Peabody and Scott Trade, as well as be within two blocks of City Museum, Union Station, the multi-modal station, two metro-link stops, BPV and Busch Stadium. It also connects with the 7<sup>th</sup> Street route on both ends.

This route might take the place of the current downtown trolley and be subsidized both by Metro and, indirectly, by the convention center – they might be able to pre-sell large batches of tickets to large conventions at a discount to the cost of the buses these conventions normally hire to transport people from their hotels to the convention center.

There has been a good deal of research done on this route, but the route is about 2 miles using Market and 3 miles using Clark, so this route may be 2 buses in each direction to keep headways below 10 minutes, and a total of 4 buses.

### **Arch Loop**

Confirm the proposed arch loop route. The S end of the Arch Park/Chouteau's Landing is not really a destination, at least not yet, and there is a lot of distance, time and cost involved in serving it. Not clear on how access to the Landing will work, but is there a route that just goes from the Courthouse to Lumiere/Landing and back, that might also serve the North Gateway and Dome (and possibly future stadium on N Riverfront)? Maybe the route includes going halfway down LKS and back? At least parts of this route might be seasonal. This route, on its own, seems like about half the distance of the recommended route in the report, but would probably still need 2 buses to keep headways below 10 minutes.

11. There is sponsorship potential from Lumiere and The Landing.

12. Total buses for all routes is 7 buses, plus 2 in reserve for peak times and to substitute in case of breakdown – assuming an average of 7 buses in service for 17 hours a day that works out to about \$3 million in up-front costs and about \$2.9 million/year in operational costs.

The key assumption that needs to be tested is does making the system 3x bigger both add efficiencies and bring in more than 3x as many riders. If so, at \$1/ride, roughly half the operational costs are covered by the fare box.

13. Other funding sources may include: Annual sponsorship - \$200,000; Increase parking tax to 7.5% - not sure, just guessing at \$150,000; Metro – could we get \$800k out of them??; NPS \$200k?; DSI TDD \$150k
14. Maybe the upfront capital costs are in a TIGER grant with match coming from DSI TDD ?
15. Annual Sponsorship sources (\$10k-\$15k ea.): MX (Embassy and restaurants); Convention Center; Renaissance; Lumiere; BPV; Cardinals; Scott Trade; Ballpark Hilton; Hyatt; USB; Stifel; B of A; Peabody

## Appendix B – Data Tables for Charts and Graphs

### Data Table for Figure 6 – Visitation to JEFF by Month

Source: Volpe Center, NPS PUSO

Year/Month	2006	2007	2008	2009	2010	2011	2012	2013
January	86,281	58,501	59,291	67,708	57,518	54,696	56,326	57,737
February	93,943	61,331	62,121	77,608	61,079	54,884	67,671	60,013
March	184,065	150,464	143,284	148,648	162,697	133,246	187,038	163,183
April	204,230	179,131	131,112	159,656	175,883	153,804	172,210	153,434
May	203,212	193,919	202,886	195,478	195,918	179,766	197,670	196,822
June	259,517	243,622	237,567	254,753	247,616	178,809	284,592	265,408
July	664,268	770,243	332,003	659,749	817,243	815,418	805,362	809,266
August	334,203	262,811	232,820	335,663	240,563	224,103	243,878	274,111
September	175,177	166,798	130,797	152,976	159,827	143,292	152,261	148,261
October	151,276	145,347	246,550	130,503	149,590	142,409	139,189	68,067
November	117,678	90,539	107,076	102,587	105,479	97,614	105,522	109,961
December	98,222	62,681	69,303	74,780	62,697	80,979	85,007	70,995

### Data Table for Figure 7 – Visitation to JEFF by Age

Source: University of Idaho, Park Studies Unit, 2012

Age Range	Percent of Visitation
0 to 15 years	29
16 to 30 years	15
31 to 60 years	45
61 and Older	11

### Data Table for Figure 20 - Fleet purchase and fueling costs EIA inflation

Source: Volpe Center

<b>Fuel Type/Phase</b>	<b>Diesel</b>	<b>CNG</b>	<b>Electric</b>
Procurement	1,050,000	1,215,000	1,580,000
Fueling	898,896	562,079	155,849
Combined	1,948,896	1,777,079	1,735,849

### Data Table for Figure 21 - Fleet purchase and fueling costs, 20-year historical inflation

Source: Volpe Center

<b>Fuel Type/Phase</b>	<b>Diesel</b>	<b>CNG</b>	<b>Electric</b>
Procurement	1,050,000	1,215,000	1,580,000
Fueling	1,105,071	630,402	146,459
Combined	2,155,071	1,845,402	1,726,459



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